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MODEL MILLS CO.'S POWER PLANT, PHILADELPHIA

ECONOMY OF WATER AND HEAT AND LABOR

BY WALTER C. EDGE

THE MODEL MILLS, which are located at I and Ontario Sts., are owned and operated by Thos. Boggs & Sons Co., Inc., manufacturers of Brussels, Ingrain and Wilton Rugs and Carpets. The mill is a 4-story re-inforced concrete building 280 by 52 ft., equipped with the most up-to-date machinery. Office is located on the first floor at one end of the building, and power house is a one-story concrete structure 92 by 35 ft., over all, situated 30 ft. from the main building.

Level with the ground is the boiler room floor, measuring 50 by 35 ft., of cement, with the addition of iron plates in front of the boilers, which set out from the wall, leaving a passageway on all sides. The room is exceptionally well ventilated and lighted.

The engine room is 4 ft. above the ground or 8 ft. 6 in. above the basement floor, and measures 42 by 35 ft. It has a hardwood polished floor, very nearly covered with Brussels rugs, and all bright work of machinery is highly polished, making an exceptionally pretty engine room.

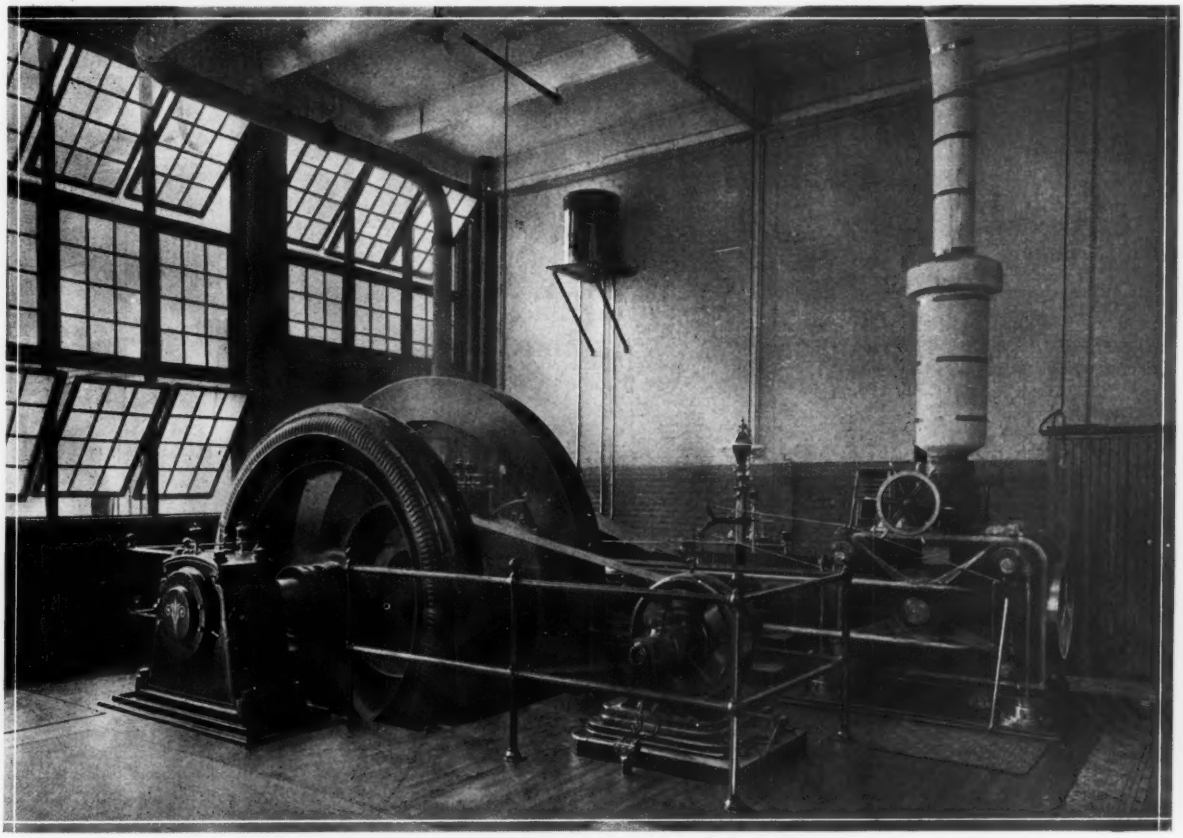


FIG. 7. GENERATING UNIT AND OIL TANK

Under the engine room is a basement 4 ft. 6 in. below the ground level making an excellent place for tanks, filters, piping, etc. This has a cement floor.

Water Supply

WATER supplied to the plant is city filtered water, brought in by a 4-in. main under city pressure. On the roof are 2 storage tanks for reserve supply, one called the house tank, and the other the fire or sprinkler tank, the entire plant being equipped with an automatic sprinkling system.

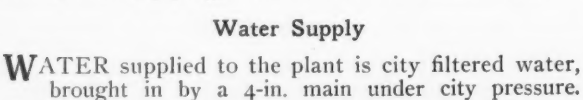


FIG. 1. THE MODEL MILLS OF PHILADELPHIA

The fire pump is a 16 by 9 by 12 in. of 750 gal. a minute capacity, made by C. H. Wheeler Mfg. Co., and located in a small room connected to the engine room. This pump is piped so that it can pump from the city mains to the sprinkler system, or the pump can be by-passed and the city pressure or sprinkler tank can be put on the system.

Boilers and Fittings

TWO return tubular boilers of 150 hp. each, measure 72 in. diameter by 20 ft. in length and are designed for 150 lb. working pressure. Each boiler has a steam drum 36 in. by 16 ft., set in the brickwork directly over the boiler.

The boilers are protected from high or low water by Reliance safety water columns, are equipped with the P. B. H. quick closing water gages, and the P. B. H. weight gage cocks. The damper is controlled by a Bushnell regulator.

Brick walls supporting the boilers, are laid upon a solid concrete foundation 24 in. deep; the walls are 30 in. wide at the bottom and 22 in. at the boiler lugs. Bridge walls are built up to within 9 in. of the bottom of the boiler and are 42 in. in width. The combustion chamber measures 36 in. from the bottom of the boiler to grate bars, and 30 in. between the rear wall and boiler.

Piping and Heating

ACROSS the 2 boilers at the back end above the boiler tops runs a 14-in. manifold 18 ft. long and all in one piece, all nozzles being electrically welded. From this manifold a 3-in. main runs to a smaller manifold in the basement under the engine room, and all steam lines for the main building are run from this small manifold, controlling valves being placed on all the lines at the manifold, so that the entire line may be cut out when necessary.

To each floor runs a 1-in. steam line to supply steam for manufacturing purposes, and a ¾-in. line runs from the heater to the office, supplying the office with hot running water at all times.

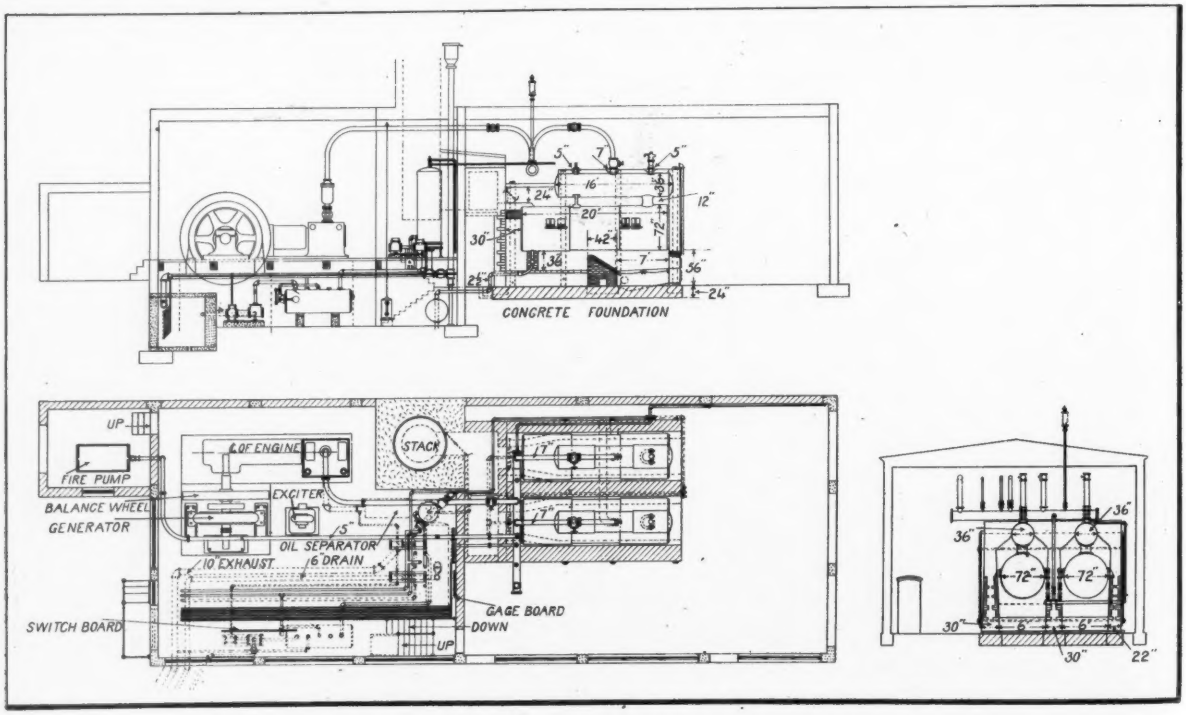


FIG. 2. PLAN, END AND SIDE SECTIONS OF MODEL MILLS POWER PLANT

Separate lines run from the main manifold, for the engine, fire pumps and feed pumps.

Boilers are connected to the header by 7-in. extra heavy expansion bends, with 2 valves on each bend.

The blowoff piping is 2½-in. extra heavy, and is run to a blowoff tank in the basement, having a 6-in. outlet to the sewer; the exposed pipe is ordinary steel pipe, while that underground is cast iron.

Vacuum Steam Heating System

EXCEPTIONALLY economical heating is secured at this plant by a system designed by James F. Marshall, the consulting engineer, in which the Dexter Water Seal valve is used on the drip end of radiators and coils. A 10-in. main exhaust line runs from the engine room to the top floor of the main building, where it branches out to risers supplying the many heating coils throughout the building. Connected to the drip return line of this system is a 6 by 8 by 10-in. vacuum pump which discharges through a 3-in. line to the receiving tank, both pump and tank being in the basement.

Owing to the large amount of glass surface in the building, practically over ⅔ of the outer surface of the building, which requires heavy heating supply and because the amount of power required to operate the factory is light, during the past heating season a vacuum of 20 in. and over was obtained in the 10-in. exhaust line from the engine, thus efficiently utilizing the condensing properties of the heating system to operate the engine condensing with low back pressure.

This feature was given careful consideration while the heating system was being designed, ample provision being made for modulating the temperature of steam in the heating coils, even to utilizing the vapor in the return line from the heating system.

Method of Boiler Feed

NO water is wasted in this plant; advantage is taken of the distilled water offered by condensed exhaust steam. In addition to this exhaust there is a 2½-in. water line entering the tank to supply the makeup water necessary for the feed pumps, water being kept at constant level in the receiver by means of an automatic float valve in the cold water line.

pump has 3 discharge lines, one going to the sprinkler tank, one to the house tank, and the third to the boilers.

Water going to the boilers is pumped through a 2½-in. discharge line, through a 300-hp. Berryman heater of closed type set in the corner of the engine

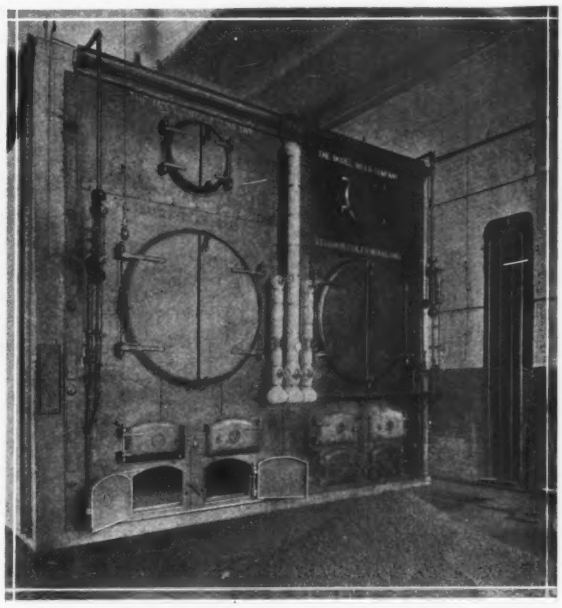


FIG. 3. BOILER FRONTS SHOWING WATER FEED AND LOCATION OF STEAM DRUMS ABOVE SHELLS

room near the pumps, and after leaving the heater the line is carried over and between the boilers and down the front to within 5 ft. of the floor, where it branches into 2 2-in. lines, one going to each boiler.

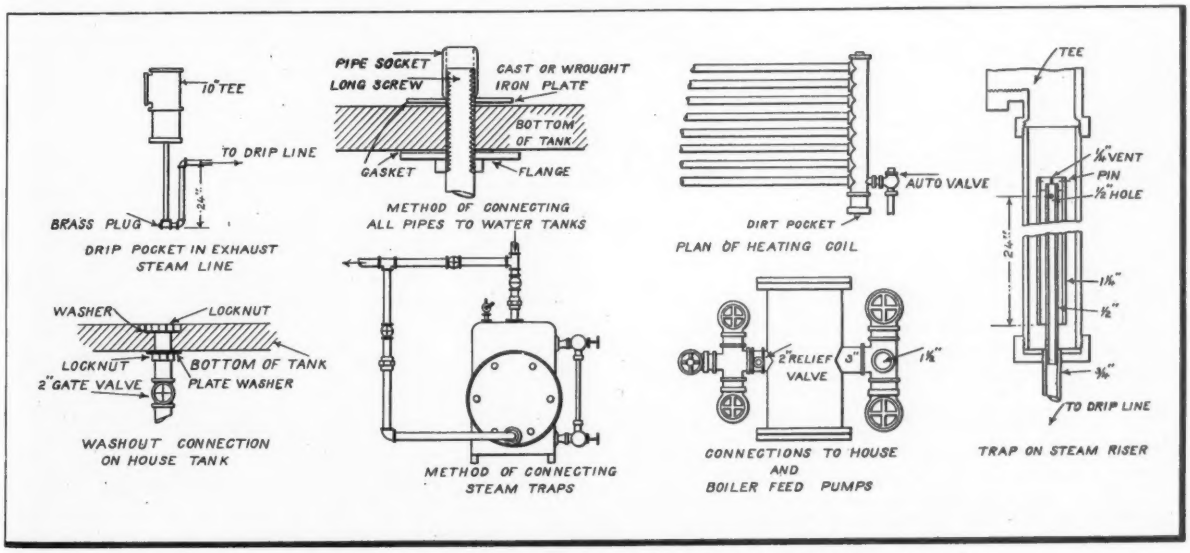


FIG. 5. DETAILS OF CONSTRUCTION IN PIPE LINES AND HEATING SYSTEM

The boilers are fed by 2 8½ by 5 by 10-in. single cylinder Burnham pumps, so cross connected that either one may do the work. They are fitted to take their supply from the city main direct, or from the receiving tank through a 3 in. suction pipe. Each

There is a thermometer in the 2½-in. line set in such position that the fireman can at all times see the temperature of the feed water.

The feed valves are placed in handy position for the fireman to operate, and both valves may be closed

at any time as the feed pumps are controlled by Ford automatic pump governors, and each has a relief valve on the discharge end, should the governor fail at any time.

Tunnel

CONNECTING the main building with the engine room basement is a tunnel 35 ft. long 5 ft. wide and 6 ft. 6 in. high, built to avoid buried underground piping; the only pipe buried is the 6-in. cast-iron blowoff pipe to the sewer, and the city main. The size and number of pipes going through the tunnel is as follows: Electrical conduits, 9 2½-in., 4 2-in.; Steam, 5 1-in., 1 1½-in.; Exhaust steam, 1 10-in.; Condensation return lines, 1 2-in., 1 3-in.; Hot water lines, 1 ¾-in.; Cold water lines, 1 2-in., 1 3-in., 1 4-in.

All this piping is so arranged that it may be easily repaired, the electrical conduit being on one side of the tunnel, and all other pipes on the other side.

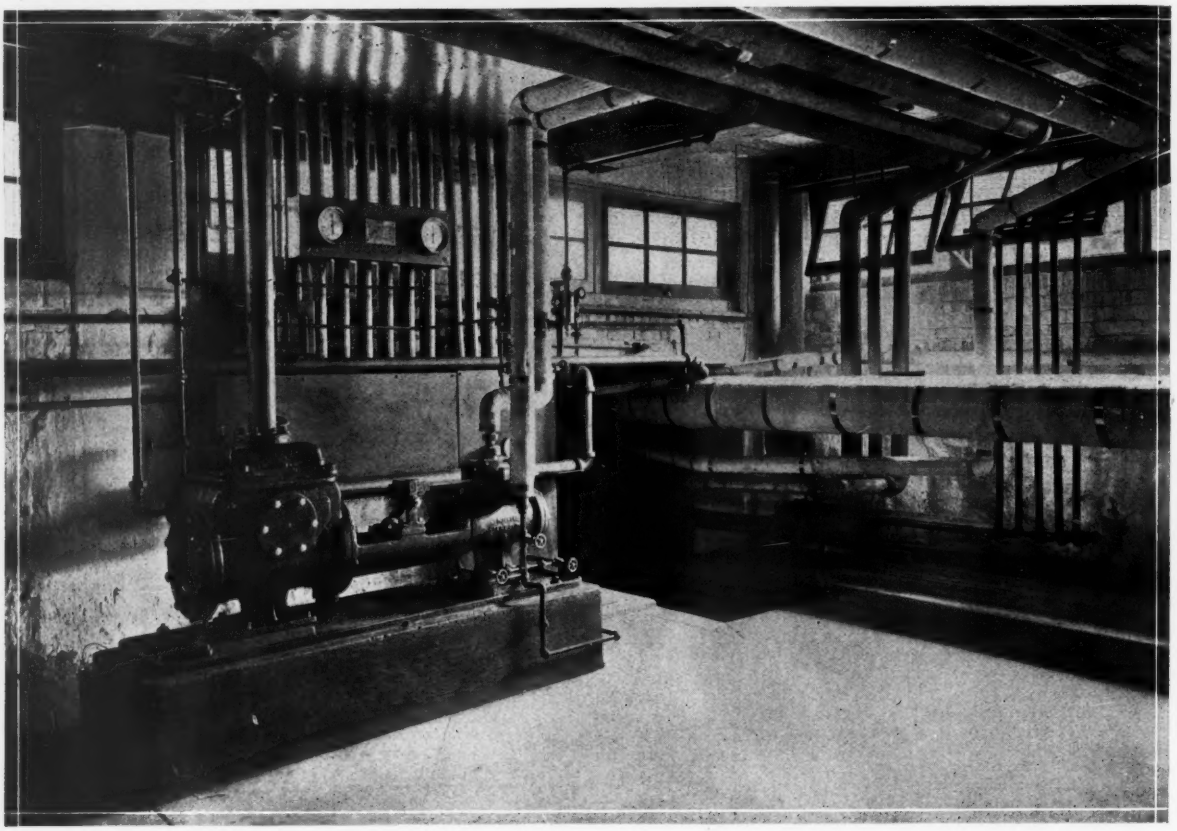


FIG. 4. ENTRANCE TO TUNNEL SHOWING VACUUM PUMP, CONDUIT AND PIPE LINES

Engine and Electrical Equipment

THE engine is a 16 by 42-in. Hewes & Phillips Corliss, running 120 r.p.m., direct connected to a 250-k.v.a. Fort Wayne 3-phase, 60-cycle alternating-current dynamo, with a belted exciter. The flywheel is 12 ft. diameter and weighs 12 tons.

The switchboard is an exceptionally handsome blue marble structure set 4 ft. from the wall, thus allowing plenty of room to work behind. All fuses are of the enclosed type and are placed on the back of the board. The board is equipped with a Terrell automatic voltage regulator, a recording wattmeter, an indicating wattmeter, a voltmeter, 3 ammeters, and a power-factor indicator.

The system of wiring is 3-phase, 220-volt for power, and 125-volts for lighting. All mains are in conduit, the branches for lighting being open work.

On the connections to the generator is arranged a neutral tap, by means of which the electric lighting service is obtained without the use of transformers, means being provided on the switchboard for balancing the lighting load between the different phases.

At the present time the plant is equipped with 12 motors, and more will be added later on. Controlling devices for all motors are in one switch box, on each floor of the main building, which is kept locked, one man being appointed to look after it.

In the basement is a 5 by 5 by 6-in. air compressor used to blow the accumulated dust from the generator fields and armature, and other places impossible to reach by hand.

Oiling Systems

THE engine is oiled mechanically by a White Star Oiling System. A storage tank is elevated so that oil will run by gravity through nickel-plated tubing from the tank to every bearing on the engine, a Gaco sight feed being fitted over each bearing, enabling the attendant to regulate the feed. These Gaco feeds are so constructed that an oil cup is placed, ready for use, when the system is not in operation.

The oil, after leaving the bearing, runs to the White Star filter in the basement by gravity and when thoroughly purified is pumped to the storage tank by

a centrifugal pump, direct connected to a motor. It is necessary for this pump to run only a few minutes each day. The oiling system makes it possible to keep a stream of oil on the bearings at all times, with no loss in oil, as it is all returned to the filter, thus

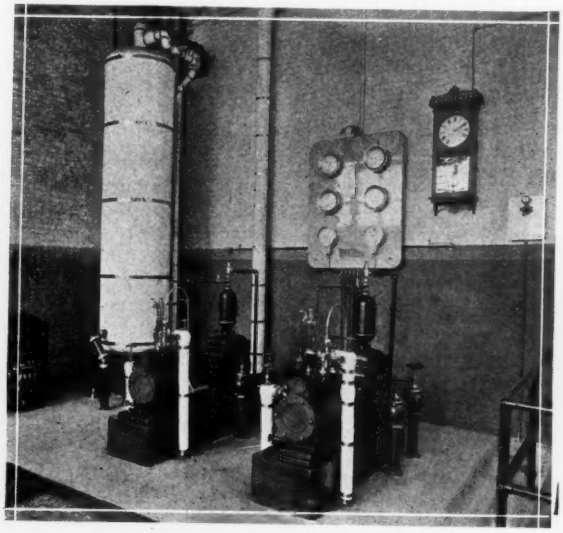


FIG. 6. BOILER FEED PUMPS, HEATER AND GAGE BOARD

reducing friction to a minimum, and averting any possible danger from hot bearings.

Engine and pump cylinders are lubricated by oil under pressure from a 30-gal. cylinder oil tank in the basement.

Gage Board

THE gage board is mounted on the wall at one end of engine room and measures 4 by 3 ft., and carries 6 gages with back connections, all nickel plated.

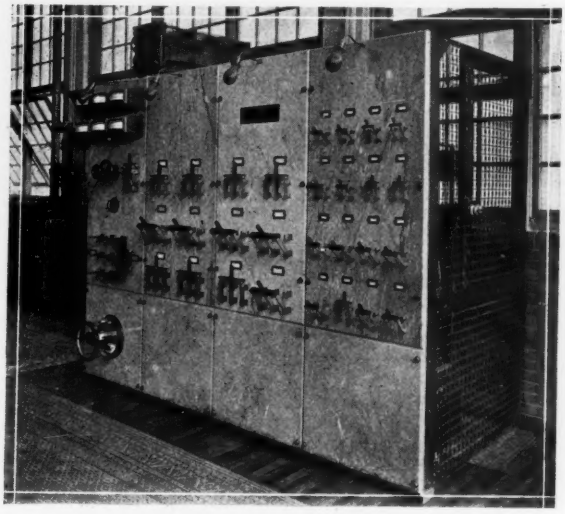


FIG. 8. MAIN SWITCHBOARD

In the upper left-hand corner is the steam pressure gage, showing the boiler pressure, and below are the vacuum gage used for the heating system, and the Bristol recording gage. In the upper right-hand corner is the water gage showing the city water pressure; under this is the back pressure and vacuum gage connected to the exhaust main, and a Bristol recording thermometer to record the temperature of the flue gases. In the center of the board is a thermometer to give the temperature of the engine room.

The chimney is 125 ft. high and 5 ft. internal diameter built of Improved Corrugated perforated radial brick by the M. W. Kellog Co., of New York.

The plant was designed by James E. Marshall, engineer, of Philadelphia, Pa., and is operated by Chief Engineer Robert M. Smalley, to both of whom the writer is indebted for assistance and information.

SOME VALVE POINTERS

HINTS ON THE CARE OF VALVES TO SAVE TROUBLE AND LENGTHEN LIFE

BY WM. H. WONFOR

CLOSE your valves at least once a week, otherwise the seats fill up, especially on water lines. The swirl of the steam or water will clean them out when you open them again.

Examine your header and nonreturn valves when you are cleaning your boilers. Scale may settle on the seat and cake, especially when they remain open for any length of time. The few minutes necessary to take the valve apart for this examination may mean protection to your boiler when something goes wrong.

A slight leak in a valve can be cured by regrinding. A few minutes time spent in regrinding your valves will save you dollars in the cost of new valves, as well as the time necessary to install them.

Lots of good valves are ruined by carelessness. After your valve is seated with firm pressure you don't have to take a monkey-wrench to squeeze it home a little further. If it does not shut off tight when closed firmly, it wants regrinding. Try it and see.

Before you install a new valve in the pipe line blow out the line on both sides. The vibration of the line, caused by the work necessary to remove the old valve, loosens the scale and sediment that has accumulated in the pipe and this settles in the new valve as soon as you turn on the pressure. Ninety-nine per cent of the new valves that are condemned as leaky are clogged with sediment that has blown through from the pipe and lodged on the seat of the new valve.

Some men think that both hands are necessary to close a one-inch valve. Others think that no valve, no matter how small, can be closed without a monkey wrench. Try a light, firm pressure on the hand wheel with the fingers of one hand and see how easy it is to close them down tight.

When you seat with a reseating machine remember that just a slight pressure is necessary. The cutting disks are sharp and often cut away more than you think for. Let up on the pressure before finishing and withdraw the tool by a revolving motion rather than directly. Finish off by regrinding with a little sand or ground glass and water applied to the disk so that the seat and disk are equal, and you will find that the service you receive from the valve will be increased by the number of times you will be able to regrind it.

AS A TEST of the capacity of its freight locomotives over a section of road where grades had been removed and curves compensated, the Pennsylvania R. R. recently ran the longest and heaviest train ever operated from Altoona to Enola, Pa. The train was 4888 ft. long, more than 0.9 mile, and consisted of 120 steel gondola cars, loaded with 6,450 T. of coal. The total train weight was 16,888,000 lb.

PRINCIPLES OF THE INJECTOR

SHOWING HOW IT WORKS, EXPLAINED BY EASY EXAMPLES

TO A GREAT MANY of us, the action of the injector seems a paradox, although this machine is one of the simplest appliances in the power plant.

Unfortunately the calculations governing the injector and its design are incumbered with intricate formulas, whose solutions can make the mathematical sharks burn the midnight oil; to most of us, who may not venture too far from the fundamental, but substantial Three R's, such formulas are unfathomable, and when they grace an article on injectors, we are very apt to read the head lines, then almost burn our fingers turning the pages to get away from those hieroglyphics. And to this, perhaps more than to anything else, may be laid the fact that the injector is so little understood by the operating men, who are satisfied to know that it works, and let it go at that.

But the fundamental principle underlying the injector's action, the only one we need care much about, is very simple, may be expressed in easy mathematics,

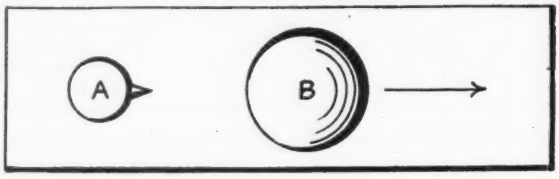


FIG. 1. THE FAMILIAR CASE OF THE FAST LITTLE BALL AND THE SLOW BIG BALL

and fully illustrated. Suppose we imagine 2 wooden balls, Fig. 1, A weighing 1 lb. and B 9 lb. Both are set in motion, traveling in the same direction, A at the rate of 2640 ft. a sec., B, 31 ft. a sec. It is evident that A is soon going to overtake B, and after the collision, it's certain B is going to travel along at a much brisker rate. That the 2 balls may act as one mass after coming together, we will imagine a sharp spike in A which will hold it fast to B.

You have noticed this many times, for instance, when a small ball rolls swiftly down the return chute of a bowling alley and meets up with a large ball, returning lazily ahead of the little one. After they strike, the big one moves on faster, the little one generally staying close behind it.

Momentum

WHEN a street car, for example, is moving along at 10 miles an hour, we know that it is traveling twice as fast as if it were going at 5 miles an hr., but in doubling the speed, another quantity called momentum, has also been increased. Momentum is mathematically expressed as the product of the mass of a body times its velocity.

To illustrate, if the street car weighed 10 tons, its momentum at 5 miles an hour would be $10 \times 5 = 50$ mile-ton units; at 10 miles, $10 \times 10 = 100$ mile-ton units.

If 2 moving bodies meet, their total momentum after colliding is equal to the sum of their individual momentums before colliding. This is one of the immutable laws of nature.

Returning now to the balls, the momentum of A $= 2640 \times 1 = 2640$ units and of B, $9 \times 31 = 279$ units. After the collision, the total momentum of the 2 bodies considered as one, must equal $2640 + 279 = 2919$ units, but there are now 10 units of weight, therefore, since momentum = weight $\times$ velocity, we can divide 2919 by 10, which gives the velocity of the combined bodies after meeting, or 291.9 ft. a sec.

The Use of Momentum in the Injector

FIGURE 2 illustrates the general features of an injector. 1 is the boiler, at, say 90 lb. gage pressure; 2, steam line to injector; 3, water supply; 4 and 5 injector; 6, delivery pipe with check valve.

Let us see now, how the 2 bodies A and B, illustrate the action of an injector. Steam at 90 lb. pressure flowing to atmosphere, would have a velocity of approximately 2640 ft. a sec. The water is falling with, say, a head of 15 ft.; at this height it will have a velocity of 31 ft. a sec.

The steam and water meet and combine very much as did A and B, and, let us suppose, in the proportion of 1 lb. steam to 9 lb. water—which is a very common ratio for injectors. The final velocity, then, is the same as in our hypothetical case, 291.9 ft. a sec. We now desire to see what the condition of affairs is at the orifice of 6, where the feed water enters just beneath the level of the water in the boiler.

The height of a column of water which would produce the same pressure on the check valve as does the steam, would be 2.3 times the steam pressure, or $2.3 \times 90 = 207$ ft. At this head, a stream of water leaving

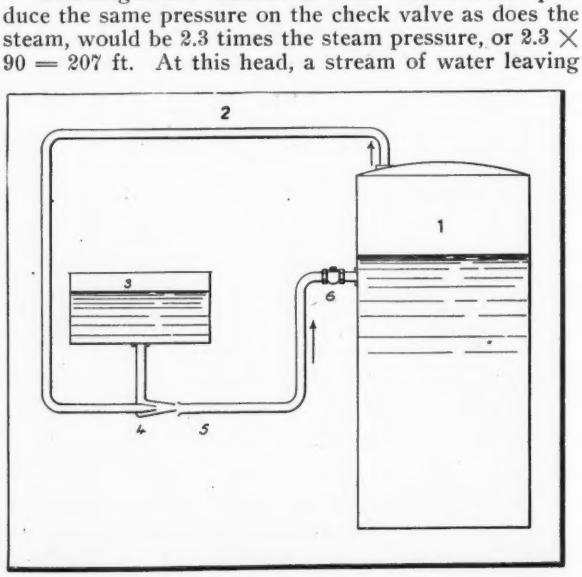


FIG. 2. ILLUSTRATING GENERAL FEATURES OF INJECTOR ACTION

the orifice would have a velocity of 115 ft. a sec., which is derived as follows:

$$v = \sqrt{2gh} = \sqrt{2 \times 32 \times 207} = \sqrt{13250} = 115 \text{ ft. a sec.}$$

This means, then, that, if we were to cut the delivery pipe, the water would rush from the boiler at a speed of 115 ft. a second, due to the pressure of the steam above it. Therefore, if a stream of water could be directed against the orifice with a velocity of a little over 115 ft. a second, it would just overcome the internal resistance, and enter the boiler. But we have a stream coming from the injector at a velocity of 291.9 ft. a second, whose momentum is more than

double that which a stream of equal size could have coming from the boiler, under which conditions not only is the water capable of entering the boiler but sufficient energy is available to overcome all pipe resistances, and, if necessary, to force the water into a boiler whose steam pressure is higher than that supplied to the injector.

The Single Tube Injector

IN FIG. 3, is shown the simplest form of an actual single tube injector, which derives its name from the fact that it employs but one steam jet.

When steam is first admitted it passes from the steam jet A, into the combining tube B, and passes out the overflow E. In passing from A to B, the steam

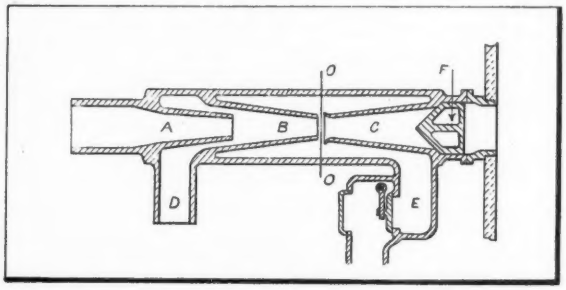


FIG. 3. SECTION OF PARTS OF A SINGLE TUBE INJECTOR

carries with it the surrounding air, which induces a partial vacuum about the water supply. Water will then rise in the supply pipe and begin to flow into the injector with a velocity depending on the vacuum produced. The high velocity steam strikes the cold water, condenses, and imparts to it considerable of its momentum, besides practically all its heat. The water

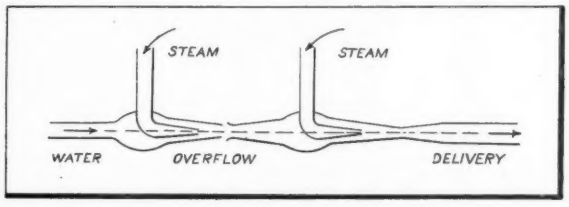


FIG. 4. METHOD OF ACTION OF DOUBLE TUBE INJECTOR

with its increased momentum, produces a pressure on the check valve F, which opens and allows the water to pass as soon as the momentum has become sufficient.

Simultaneous with the opening of the check valve, the stream through the overflow ceases, and the entire supply enters the boiler.

The Double Tube Injector

BY ARRANGING 2 jets, one behind the other, or in series, it is possible to add their individual energies and overcome resistances impossible or impracticable with a single tube injector, a principle which has found wide application in the positive or double-tube type. An ideal form of the double tube, or compound injector, as it may be called, is shown in Fig. 4.

In practice, however, the energy of each steam jet is applied directly to performing only one of the functions of the injector; to the first tube is given the burden of lifting the water and causing a flow through the injector, and consequently it is termed the lifted; the duty of the second jet is to force the water into the boiler, and it is therefore called the forcer.

To make each of the tubes the more efficient for its particular purpose, the finer points of design covering the shapes, sizes and lengths of the tubes, are taken into account. The arrangement of an actual compound injector is shown in Fig. 5. In practice, steam is first admitted to the lifter or lower jet, until a steady continuous stream of water is observed at the over-

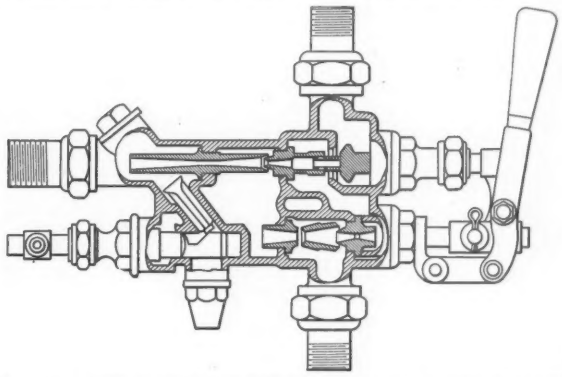


FIG. 5. ACTUAL ARRANGEMENTS OF DOUBLE TUBE INJECTOR OR INSPIRATOR

flow. When this is established and regulated, the forcer is opened slowly until the overflow ceases, which indicates that the boiler is receiving the water.

BOILER FEEDING

METHODS EMPLOYED, INJECTOR OPERATION

By Charles L. Hubbard

FEED water is commonly supplied to a boiler in one of 3 ways; the simplest being by means of city pressure which is usually applicable only to heating boilers or those carrying a moderate steam pressure. In the case of high-pressure power plants either an injector or some form of pump is employed. Often both of these means are provided as a safeguard against a breakdown or accident. The requirements of a good feed apparatus are that it shall supply a sufficient quantity of water as required, and that it shall not fail to operate properly when called upon for service. Capacity and reliability are the main features to be observed in selecting a feeding device.

Injectors

THE action of an injector is always more or less mysterious to one not familiar with the principles upon which it operates. This is due largely to the fact that steam is made to flow back into the boiler against its own pressure, and at the same time carry with it a certain volume of water. The action seems still more impossible when steam at a lower pressure is used to operate an injector feeding a boiler under a higher pressure.

The working of the injector can best be described by referring to Fig. 1, which shows the interior construction of a standard make. Steam from the boiler enters at A through a valved pipe connection. Water is supplied through B, and C is the feed connection to the boiler. Each of these are provided with stop valves, and C has in addition to this a check valve opening toward the boiler. D is an overflow and E a light check valve which closes by its own weight aided by atmospheric pressure when the injector is working and a partial vacuum exists in the chamber J. In

starting the injector, the stop valves in B and C are first opened, then the valve in A, thus admitting steam to the tube F. This flows across the gaps, first into G and then H, and so into the pipe C, but not with sufficient pressure to open the check into the boiler. It now backs up through H and flows from the gap at the upper end of the tube into the space J. The pressure thus formed is sufficient to raise the check E and allow the steam to flow into the atmosphere through D. As the steam passes through the gap between F and G it draws the air out of chamber I, thus causing a vacuum which allows it to fill with water from B. The steam jet passing through F and G has a high velocity and a certain amount of water is drawn in through the gap between them in the same

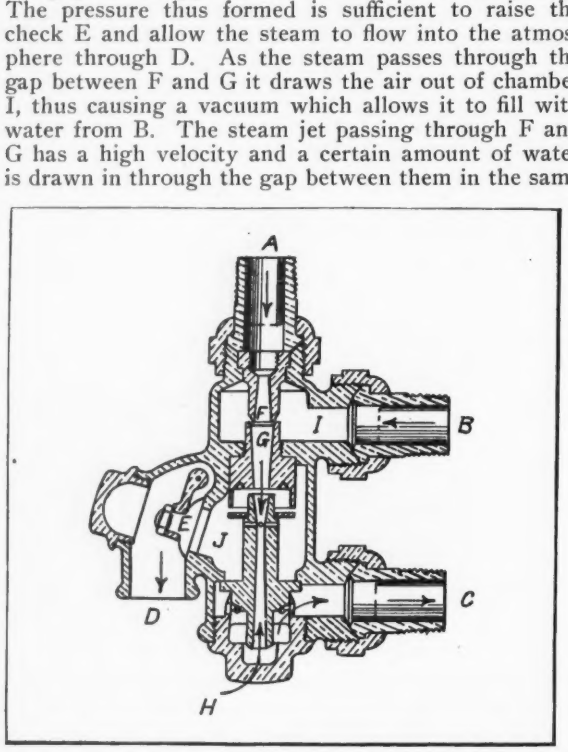


FIG. 1. CROSS SECTION OF AUTOMATIC LIFTING INJECTOR

manner as the air was exhausted from chamber I. The steam flowing from F possesses a certain amount of kinetic energy or energy of motion, and upon meeting the water in tube G tends to draw it along by the action of friction. This reduces the velocity and at the same time condenses the greater part of the steam. Although reduced, the velocity is still sufficient to carry the column of water through the tube H and so into the pipe C.

As the column passes through the gap between G and H, air is exhausted from the chamber J, which causes the valve E to close and thus prevent the overflow of steam and water at D.

The water continues to be forced into the lower chamber of the injector and the pipe C, until its pressure becomes greater than that inside the boiler. This is so because on the boiler side of the check valve there is a column of water under steam pressure producing a certain static pressure on the check. On the other side there is a column of water moving at a considerable velocity and backed by the same steam pressure. The energy contained in this moving column is therefore sufficient to raise the check and force the water into the boiler.

Injectors come under 2 general classes, the lifting and nonlifting. The first are so constructed as to be able not only to force water into a boiler, but to lift it from a lower level also. The nonlifting injector does not possess this feature, and therefore must receive its supply either from an elevated tank or under pressure from a city main. Lifting injectors are also divided into automatic and positive. That shown in Fig. 1 is of the automatic type and is so constructed that if the flow of water is interrupted for any reason it will be resumed automatically. The positive injector (see Fig. 2) commonly has 2 sets of tubes instead of 1; one of these is for lifting the water and the other for forcing it into the boiler. Also the automatic valve E (Fig. 1) is replaced by a hand valve, marked 1 in Fig. 2. When the flow in this type is broken it is necessary to shut it off and start it again by hand. To operate this make of injector, first open the overflow valves 1 and 3, close 2 and open starting valve in steam pipe. When water appears at the overflow close 1, open 2 a quarter turn and then close 3. The injector will then be in operation. When not in use, open both 1 and 3 and allow the water to drain from it.

An injector requires about the same amount of steam as a good pump, but has the advantage of returning all of the condensed steam to the boiler, the only loss being that due to radiation. It has the advantage of being cheap in cost and simple in construction, thus requiring small outlay for repairs. On the other hand

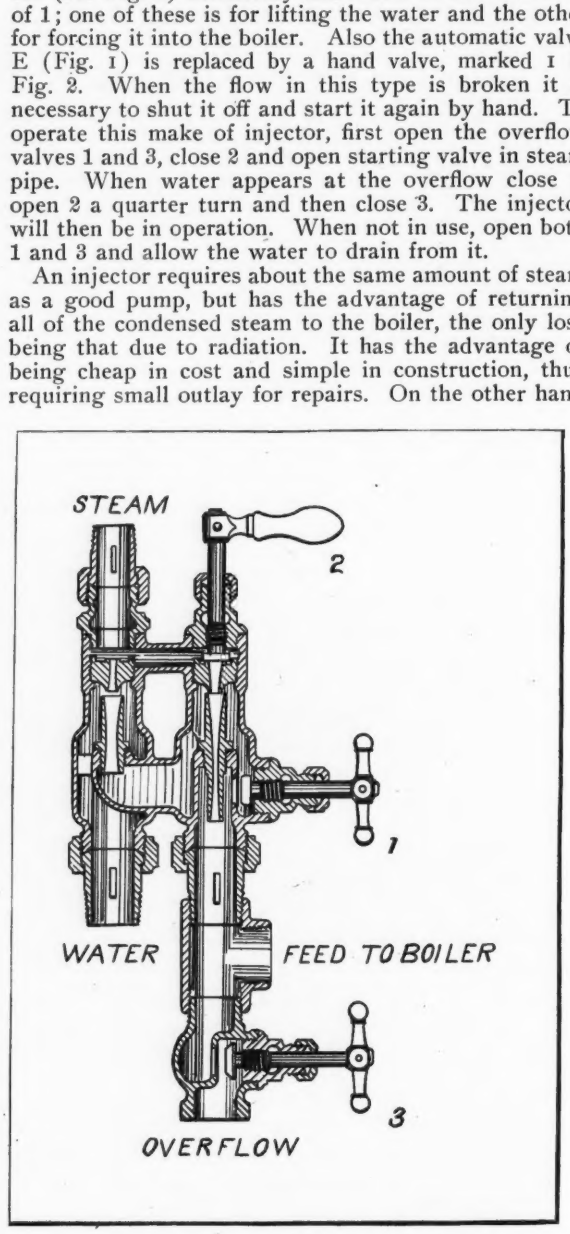


FIG. 2. POSITIVE DOUBLE TUBE INJECTOR

it is a most unsatisfactory device if it is not operated under the conditions for which it was designed. In this connection it may be well to speak of some of the troubles to which the injector is subject. First, when connecting up an injector, care should be taken to blow out all of the piping to free it from scale, red lead or other substances which might clog the nozzles. In case the injector fails to work, it should be disconnected, the cap or plug removed and the tubes or nozzles cleaned. When it fails to lift water the trouble may be due to an air leak in the suction pipe. Another

cause of failure is the choking up of the overflow, due either to the accumulation of sediment or to poor pipe connections which do not allow of a free passage for the steam and water. If the supply pipe becomes very hot it should be cooled with cold water, or the hot water may be disposed of by turning steam on and off suddenly by means of the stop valve. Trouble will also be experienced if the steam pressure and the lift are not properly proportioned. When the injector will raise water but will not force it into the boiler, the trouble is generally due to an insufficient supply. A defective check valve in the delivery pipe, which is stuck or not properly set, may tend to produce the failure of an injector. When the injector starts properly, but breaks the vacuum, it indicates that either the supply of water is not properly regulated or a leak exists in the supply pipe or that the disk of the steam valve is loose. Connecting the steam supply pipe to pipes which are used for other purposes also causes numerous difficulties which are often hard to locate.

TYPES OF INJECTORS

DETAILS OF CONSTRUCTION WHICH VARY THEIR ACTION AND MODIFY THE USES

IF you went to buy an injector and the salesman showed you what he called an inspirator, what would he mean? And where would your wise look help you? And when the new "lifting and forcing" instrument came were you able to tell that it was a nonlifting device that had been shipped by mistake,

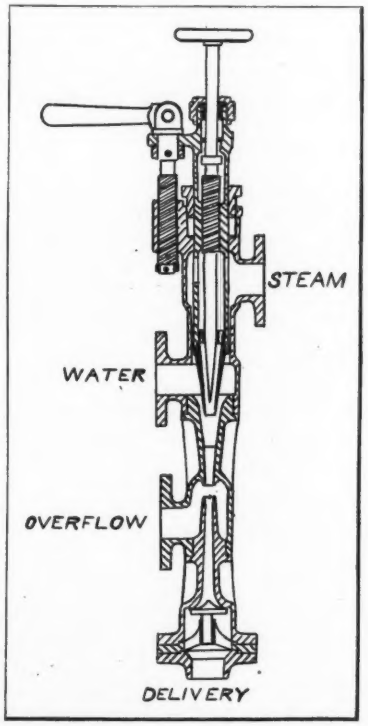


FIG. 1. SECTIONAL VIEW OF A MODIFIED GIFFARD'S INJECTOR

or did it get nicely installed and would neither lift nor force, so that a man had to come from the factory to find out the mistake?

As stated in the above article on Boiler Feeding by Mr. Hubbard, there are 2 classes of injectors, i. e., lifting and nonlifting also another instrument which works on a similar principle, but only for lifting or transferring liquids, is called the ejector.

There is little apparent difference in the design of the lifting and nonlifting types of injectors of the simple forms, the relative size and shape of tubes causing the difference in action. Lifting injectors are so constructed that they will lift the water from a lower level and at the same time force it into the boiler.

Positive Injector

TO accomplish these results several means have been resorted to. The first designs all depended upon hand regulation for starting. Thus in Fig. 1, which is a view of a modified Giffard's injector, the amount of steam allowed to pass through the steam nozzle was controlled by a needle valve. To start the water flowing to the instrument it was necessary to cut the supply of steam down to such a point that it would all

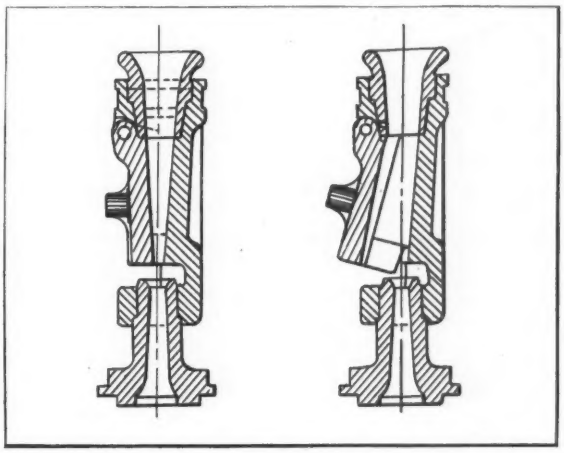


FIG. 2. COMBINING TUBE OF FLAP NOZZLE INJECTOR WITH FLAP CLOSED AND OPEN

pass through the combining tube and out the overflow, for if more than this amount be supplied, the resistance of the combining tube will cause the steam to back up and destroy the vacuum which should be formed to lift the water. Once the water has been lifted to the combining tube, it condenses the steam as rapidly as it issues from the nozzle, and the steam valve is then turned fully open to give the combined stream force enough to drive it into the boiler.

It will be noted that in this instrument there are 2 adjustments possible, one controlling the supply of steam, the other regulating the water supply. The amount of water that can be delivered to the boiler depends upon the steam pressure, temperature of feed water and height of lift, and the adjustment controlling the supply must be regulated accordingly.

There have, of course, been a great many styles of regulating valves employed in the operation of injectors, but the principle explained above applies to all. This is known as the positive injector since its action is entirely under the control of the operator.

Automatic Injector

IN the operation of an injector, it frequently occurs that the supply of water is temporarily interrupted or the steam pressure suddenly lowers considerably, and once the water fails to reach the combining tube, it is necessary to manipulate the regulating valves

before the instrument will again deliver water to the boiler.

To overcome this inconvenience and resulting waste of steam the type known as automatic has been developed. In these injectors the form of the combining tube has been altered somewhat from the simple type in order that all the steam which will issue from the steam nozzle when the valve is wide open will pass directly through the combining tube to the overflow when no water is present to condense it, thus

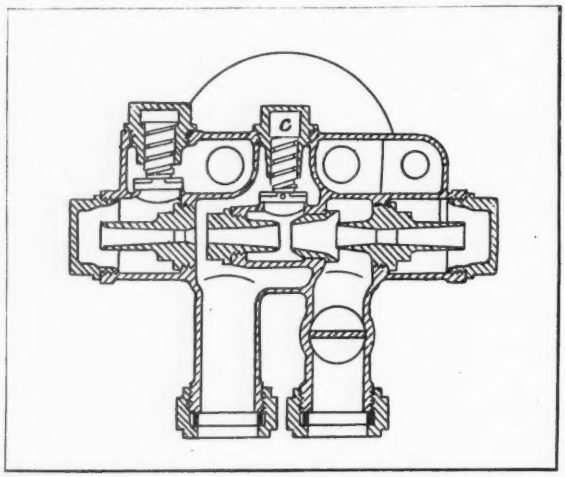


FIG. 3. INJECTOR WITH DIVIDED COMBINING TUBE

forming a partial vacuum in the water chamber which causes the water to be lifted to the instrument.

It is evident that the opening in the combining tube at the delivery end must be larger than the opening in the steam nozzle since the steam jet is bound to spread some when water is not encountered in the combining tube. One of the early forms of tubes

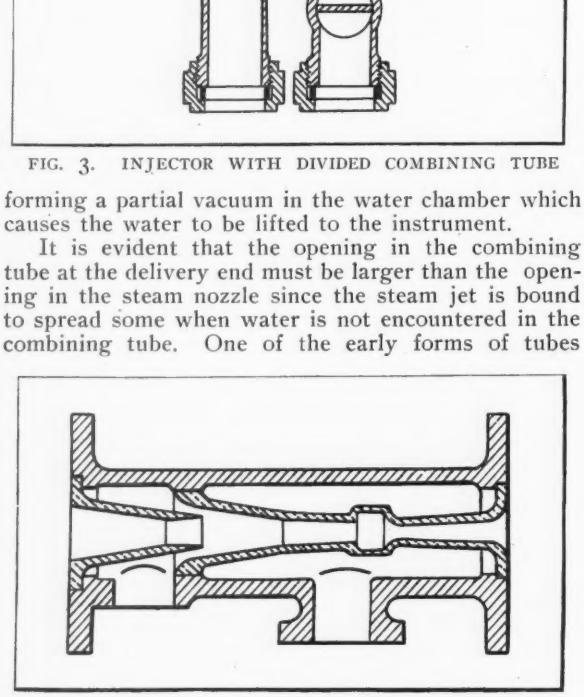


FIG. 4. SIMPLE NONLIFTING INJECTOR

which answered this requirement is shown in Fig. 2, known as the flap nozzle type. It will be seen that in this combining tube a section is hung upon a pin, when starting the instrument this section rises and allows free exit for the steam, but as soon as water begins to flow a partial vacuum is formed in the tube which closes the flap up tight, making it, in all respects, like the simple nonlifting type combining tube.

At any time, therefore, that the stream of water to the instrument is interrupted it will be re-established automatically as soon as the cause of the interruption is removed.

Another means resorted to to accomplish the same result is that shown in Fig 3, where the combining tube is divided into 2 parts with an open space between sufficiently large to allow the steam to pass without banking up in the water space when the steam valve is wide open. In this case what steam cannot pass through the entire length of the combining tube passes out to the overflow through the check valve C, which closes immediately when water reaches the injector. The instrument is thus made automatic and restarting.

Double Tube Type

LIFTING injectors are sometimes made with 2 tubes, when they are called compound. The principle involved is precisely the same as with the single tube except that one tube lifts the water to the second tube, which forces it into the boiler. The forms of

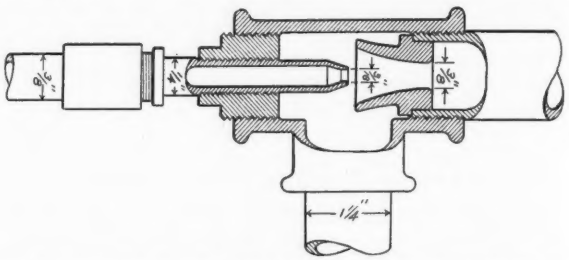


FIG. 5. SECTIONAL VIEW OF EJECTOR SHOWING DIMENSIONS

the tubes are somewhat different, those in the lifter part taking the shape of ejector tubes, while the forcing element is similar to a nonlifting injector. The details of the various types of injectors now upon the market are described in another article in this issue.

Nonlifting injectors are so constructed that the water must be supplied to them under pressure. A section of a nonlifting type injector is shown in Fig. 4, where it will be seen the tubes are all stationary, being adjusted before leaving the factory. When once put into operation it will continue to deliver water to the boiler as long as the conditions remain unchanged, and, according to adjustment, will work within a certain range of steam pressure and water temperature.

In detail of construction ejectors are similar to a simple form of lifting injector without a delivery tube, and having a short combining tube; a cross section giving dimensions of such an instrument is shown in Fig. 5. The purpose of this appliance, as stated previously, is to lift or transfer liquids that will not be injured by heat or condensed moisture. They may also be used for removing gas from a mine or pit, or when properly arranged, serve as an efficient sand blast.

INVESTIGATIONS of possible sites for developing water power on the public domain are being pushed by the United States Geological Survey, with resulting withdrawals of land from entry where it is found that valuable sites exist. In July 31,725 acres of such land were withdrawn, including a great number of power sites. No estimate has been made of the horsepower involved, but owing to the character of the power sites withdrawn it is believed to be very large. These July withdrawals make a total outstanding area withdrawn of 1,546,258 acres, based on the examination and recommendation of the Geological Survey, and involving thousands of power sites and millions of horsepower. The withdrawals are made in aid of proposed legislation by Congress which shall provide for the fullest possible development of these enormously valuable properties and at the same time guard the public interests.

CAPACITY AND SELECTION OF AN INJECTOR

CONDITIONS WHICH MAY BE MET AND THEIR EFFECTS

DETERMINING THE RIGHT INJECTOR to use for some particular work, is not the difficult problem it at first appears. Many engineers, and well informed ones, too, will side step an injector argument, and there is perhaps good reason for this, for information and data, in clear, condensed and readily understood form are not as plentiful as they might be.

Factors which should influence the choice of an injector are as follows:

Capacity

THE capacity of an injector is dependent on:

(1) The steam pressure carried. In all cases, if the pressure varies, the limits of fluctuation must be known.

(2) Temperature of the water supply.

(3) Location of water supply, whether it will flow to the injector or must be lifted.

(4) The service; the character of the water; the jars the injector must stand, etc.

For any boiler feeding purpose, it is poor practice to select an injector of just sufficient size to meet the requirements; instead, an over capacity of from 30 to 50 per cent should be allowed, for the reason that the operation is liable to be impaired, in time, by corrosion, wear from gritty water, varying steam pressure, scale, or increase in the lift.

There is always one predetermined steam pressure at which capacity is a maximum; a decrease or increase in pressure, from this point involves a decrease in capacity. The range of pressure through which the injector will operate is determined between the pressure at which water will just be lifted and forced into the boiler, and that at which the steam cannot all be condensed and therefore blows through the overflow.

The effect of an increase in feed water temperature is a decrease in the height to which water can be raised, besides a reduction in the steam pressure which may be carried, thus reducing the range of the instrument. The value of cool feed-water may be understood by a study of the table, remembering that the degree of vacuum limits the height to which water can be raised.

Vacuum in. Mercury	Water Temp. deg. F.
0	212
11	190
18	170
22½	150
25	135
27½	112
29	72
29½	52

It is seen that with hot water the vacuum is decreased, or destroyed, rendering the injector inefficient or useless.

Capacity is always greatest, if the water supply flows to the injector or is taken from city mains. Lifting involves an extra duty and must be allowed for.

The delicacy of an injector is really to be wondered at; a small amount of wear caused by grit, sand, etc., in the feed water has been known not only to decrease the capacity but to make the injector inoperative. A thin film of scale, deposited in the tubes has effected a like result.

Working Conditions

IF a high steam pressure is to be carried, the double tube or positive injector is, of course, the best and proper selection, as it is designed wholly to meet this condition efficiently. Its ability to handle hotter water again favors it, the high temperature of a boiler delivering high pressure steam demanding as hot feed water as possible for both economy and safety. For this reason it is universally adopted on locomotives.

On traction, hoisting and similar engines, jarring and shaking will break the steam in the injector, or often expose the end of the feed water hose. The frequency with which such things happen, limits the selection of a suitable injector to the automatic, whose ability to restart, upon interruption, has given rise to its name. This type is also used in marine service, where rolling of the ship often exposes the sea-cock above the surface of the water.

While deciding on the type to suit the service, it is equally important to consider the structural features. The working parts of an injector being adjusted with great care, it is advisable under favorable conditions, to select a design which prevents, as far as possible, the tinkering of the fellow who always must "see what's inside," or the fellow who thinks he can "make 'er work a little better."

But, if the feed water contains corrosive, or scale-forming elements, it is imperative that easy accessibility of all parts for cleaning or replacement be provided.

Moreover, if the replacements are home-made parts, the injector must have been liberally designed to allow for the errors or differences which are sure to occur in the home-made parts.

Using the Charts in Selecting an Injector

INJECTORS are usually made in 2 sizes for each size of pipe. In Chart 1, (see Practical Reference Tables) 2 curves are given for each injector, the numbers corresponding to the pipe sizes. The curves in Charts 1, 2 and 3 are calculated on an assumption of 60 deg. F. water temperature and no lift. No allowance is made for a decrease in capacity due to usage, which amount is left to the user's judgment.

Knowing the boiler pressure, proceed vertically on Chart 1 to the curve of a given sized injector; then follow from this intersection horizontally, the capacity in gallons per hour being found on the scale at the left.

To ascertain whether the capacity is sufficient to feed the boiler, refer to Chart 2. The 3 curves represent allowances of water evaporated per horsepower hour, this quantity varying with the kind of boiler and engine or pumps in which the steam is used.

The capacity of an injector being known, proceed horizontally to the appropriate curve, then vertically down to the horsepower scale, where the horsepower capacity may be read.

This whole operation, of course, may be reversed, starting at the boiler horsepower scale and working backwards.

Chart 3 shows the loss in capacity due to lift. If the desired injector must lift its water, say, 10 ft., its capacity should be 20 per cent. greater than when not lifting.

Chart 4 determines the steam used per hour by an injector, which values also are subject to correction when lifting.

INSTALLATION AND OPERATION OF INJECTORS

PRECAUTIONS TO BE TAKEN WHEN SELECTING THE LOCATION OF AN INJECTOR AND MAKING CONNECTIONS, AND POINTS TO BE WATCHED IN THE OPERATION OF THE APPARATUS

WHEN the pump gets out of whack, the injector must save the day. In many plants the injector saves all the days. And so, as it is the court of last resort in your emergencies, it's well to see that the court is properly constituted and in good working order. Beforehand attention is the ounce of prevention.

Friction in the suction or discharge pipes must be avoided as it will cause breaking and unsatisfactory working. In particular, a long suction pipe, or numerous turns and elbows are to be avoided, and in the discharge pipe, sharp angles, and a check valve which does not swing freely, are to be guarded against. In selecting the location, the injector should be so placed as to get these connections short and direct, and also so that the apparatus is accessible for operation, and can be easily disconnected for inspection and overhauling.

Steam supply should be taken from the highest point in the boiler, in order to get dry steam, and

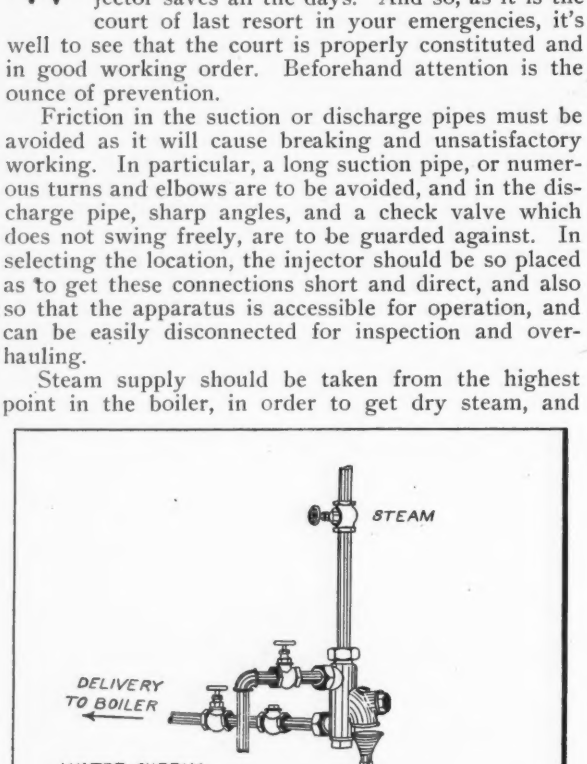


FIG. 1. CORRECT INSTALLATION OF INJECTOR FOR LIFTING

should be carried direct to the injector. It is so handy to take steam from a pipe which supplies other apparatus, but you are likely to get a fluctuating pressure which will cause unsatisfactory operation. Care should be taken that the steam valve is tight, so that steam will not leak and heat the injector when not working, and it is well to set this valve some distance from the injector so that, if by any chance steam does leak through, it will condense before reaching the injector body.

In making connections, it is important that all piping should be thoroughly blown out to remove scale chips and all other foreign matter so that the injector will not become clogged. Put a good strainer on the end of the suction pipe if you would be on friendly terms with your injector. It is also important that there should be no leaks, especially in the suction pipe, as an air leak will cause irregular action and possibly breaking of the injector.

Arrange the overflow, with a break between the injector and the pipe which carries away the water so that the action on the overflow may be seen at all times and there may be no back pressure on it. The valve in the suction pipe should be placed as close to the injector as possible, and in the discharge pipe there should be a check valve, and a stop valve between the check valve and the boiler.

Operation of the Injector

IN the daily attendance it is best always to start the injector carefully, and to note its operation so as to detect any variation from normal conditions. The injector is simple in construction, and ordinarily needs no care beyond the starting and stopping and seeing

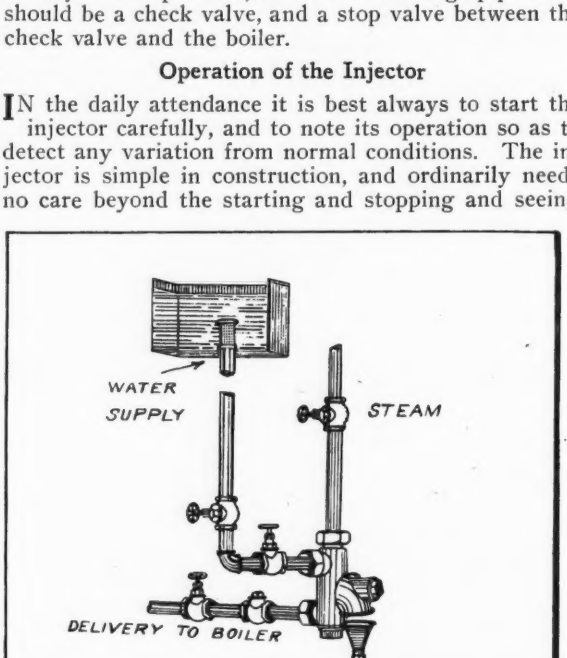


FIG. 2. USE OF 2 WATER VALVES WHEN SUPPLY COMES UNDER PRESSURE

that water supplied to it is carefully strained so that there will be no particles to catch in the injector orifices and cause trouble. A grain of dirt the size of a pinhead properly wedged into an injector tube will cause as much trouble as a fishbone in your throat.

At regular intervals the device should be disconnected, taken down and examined to make sure that the nozzles are in good condition, that all openings are free and unobstructed and that in particular any angular openings are clear.

In case of failure to operate, the first points to be examined are steam and water connections to make sure that there are no leaks. The easiest method of doing this is to close the valve in the discharge pipe, screw a plug into the overflow and turn on steam. In testing for a leak in the suction pipe it may be well to see that that pipe is filled with water before turning on steam, as the steam pressure will then force water out of the leaks.

If the injector starts all right, but breaks after starting, it is usually due to the air in the water supply, or sometimes to a loose steam valve disk, which partially closes the steam opening, or to an irregular water supply such as may occur, if the water in the suction connection is taken from a pipe which supplies other apparatus.

It is important that all valves should be kept tight; a hot injector will not start well, and if the water comes to the injector under pressure and the water valve leaks, it will mean a trickling of water through the apparatus which may cause wear on the nozzles and in any case is likely to cause the deposit of scale in the various passages. Scale is just as nice in an injector as in a boiler, not a bit nicer.

Varying steam pressure will also cause failure to operate satisfactorily, and should be watched, if there is unsatisfactory working. A check valve in the delivery pipe which is stuck, or which opens only part way, may put an undue resistance on the discharge end, and thus cause trouble or cut down the capacity of the injector.

If you can Sherlock Holmes no trouble in the steam or water connections, the injector should be disconnected and the nozzles and passages carefully examined.

Sometimes a particle of dirt or scale will lodge just so as to split the smooth jet and this will cause the injector to act like a surly broncho. Sometimes it will be found that there is a slight corrosion or rough spot in the nozzle which is making trouble. This must be removed as carefully as possible, so as not to change more than is absolutely necessary the size or shape of the nozzle passage.

Sometimes it will be found that the nozzles are coated with scale. In such case the best remedy is to close the openings of the injector, fill it with a solution of one part muriatic acid to 10 parts water, and allow this to stand over night. It is the object to dissolve or loosen the scale so that it can be removed, but, if the solution is allowed to stand too long in the injector, it may cause pitting or corrosion of the metal surfaces which will make trouble. If the injector cannot be filled with the acid solution, the nozzles should be removed and put into a pan of the solution to soak for 10 to 12 hr.

Difficulty may be encountered in starting an injector on account of a hot suction pipe, or hot water in the suction. This can sometimes be overcome by stopping and starting the injector, simply allowing the water to pass out of the overflow until the supply pipe is cooled down by the incoming water.

If water comes readily through the overflow, but will not go to the boiler, the difficulty will probably be found in the discharge pipe, a sticky check valve, or possibly a loose disk in the stop valve. This difficulty may also come from low water supply, or the valve in the water supply pipe may not be wide open, thus cutting down the supply of water so that the steam is not condensed rapidly enough to give the required amount of energy to the water jet which goes to the boiler.

Feed Heating With the Injector

HEATING of the feed water takes place automatically by the action of the injector, but sometimes it is found desirable to heat the water even hotter than will be done by the steam from the injector. It is of course, impossible to take the water into the injector at high temperature, therefore it becomes necessary to heat the water after it leaves the injector. A device employed in one plant is shown in the illustration herewith, the water coming into the pipe which heats the water from the injector. The heating surface consists of a loop of 1¼-in pipe, placed inside the exhaust pipe from the engine and connected to ¾-in pipe which carries the water to and from the heating section. This ¾-in. pipe is the same size as the injector connection, and is used up to the heating coils so that the water travels fast and loses little heat. Using the 1¼-in. pipe for the heating coils, gives slower passage of the water, and therefore a greater amount of heating, and the ¾-in. connection from the heating coils

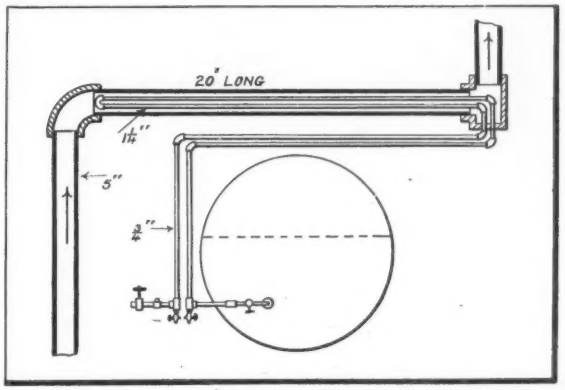


FIG. 3. FEED-WATER HEATER FOR USE WITH INJECTOR

to the boiler again gives high velocity and cuts down loss of heat. By inserting the 2 ¾-in. tees as shown both pipes can readily be drained in cold weather.

Points to Watch

SUCTION: Leaks in pipe or joints; clogged strainer; loose hose lining or hose collapses; leak around valve stem; supply water too hot; loose disk in valve; sticking foot valve.

Steam: Connection to pipe where pressure varies; wet steam; loose disk in valve; pressure too low for lift; pressure too high on long lift; leak between steam valve and injector; valve leaking.

Injector: Dirt or scale in tubes; pitted or scored tubes; steam openings stopped up; overflow valve not tight; buckled body due to pipes out of line; jets out of true from hammering injector.

Delivery: Check valve not opening full; check valve leaking; pipe choked with scale; leaks in joints or pipe.

THE MODERN SCIENCE CLUB, of Brooklyn, is starting in a season of wide activity and will conduct courses on different power plant topics, the first course embracing mathematics for engineers, beginning Oct. 6. The second course, beginning Oct. 9, will consist of lectures on fuels and generation and distribution of steam, and steam engine design and operation. The club is getting out a series of calendars for each month giving the details of the Tuesday night lectures and other special affairs of the club.

THE YEAR 1910 shows a heavy increase in the consumption of coal and establishes for the first time an output exceeding half a billion short tons, which includes the combined production of anthracite, bituminous and lignite. The total value was $629,529,745 at the mines. The output showed an increase of nearly 9 per cent over 1909, with prices ranging enough higher to increase the total value 13½ per cent.

INJECTOR TROUBLES THAT I HAVE OVERCOME

HINTS WHICH WILL PREVENT TROUBLE OR SUGGEST ITS CAUSE AND CURE

By Frank J. O'Leary *

As compared with the length of time the majority of other accessories have been used in the handling and generation of steam, the injector is of so recent origin that the principle upon which it works has not until lately been fully understood by all classes of steam engineers.

Development of injectors began with their application to steam boilers of railroad locomotive engines, in which service there has always existed a standard method of attaching them. If a lifting injector is used, it is located in or near the cab slightly above the high water level of the tender. This being the adopted location of the injectors for nearly all locomotives, it simplifies the work necessary to produce an efficient injector, because each injector is required to work under exactly the same conditions.

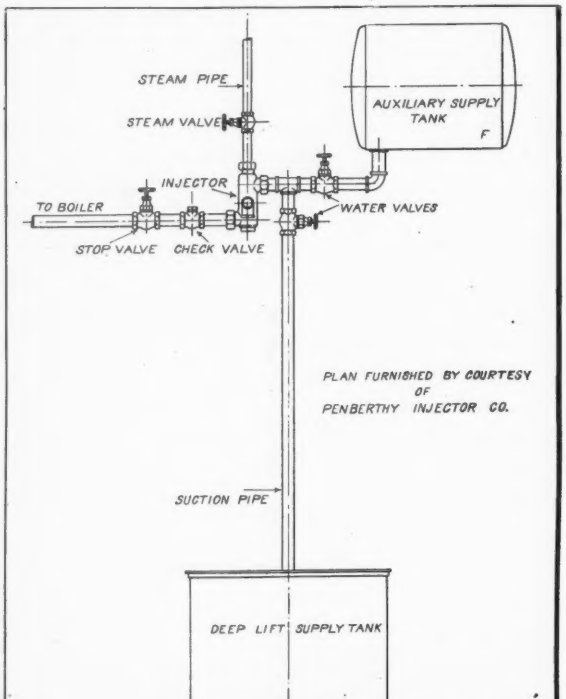


FIG. I. ARRANGEMENT FOR HIGH LIFT WITH LOW STEAM PRESSURE

In the application of the injector to general stationary boiler service, the injector must work under many different conditions. Sometimes it is required to lift its supply from very deep sources, while at other times its supply is above the injector. Hot water supply and great variation of steam pressures also are met with by the injectors used on the boilers such as are in manufacturing plants and on traction engine boilers used in agriculture. On account of these various conditions it is more difficult to produce a generally efficient injector for stationary boiler service than it is to produce one for the more uniform requirements of railroads.

*Mechanical Expert for Penberthy Injector Co.

Injectors of the automatic type lend themselves more efficiently to the various conditions of service of stationary and agricultural boilers, but many conditions exist which make it necessary for the manufacturers of the stationary boiler injector to make special injectors and for some extreme conditions. To make an injector capable of fulfilling the requirements of some cases, a study of the location of the water supply is necessary so that advantage may be taken in arranging the piping to aid the working of the injector. Such study falls usually upon the injector expert for the company manufacturing the injector and since many times in my experience I have overcome difficulties with injectors, I believe that a relation of some of these experiences, illustrated with piping plans, will be of help to engineers.

High Lift on Low Pressure

FREQUENTLY injectors are used on very low steam pressure under circumstances where the injector must lift the water from deep sources. To illustrate: We wish to use an injector to supply a boiler carrying but 20 to 30 lb. steam pressure and the water supply is 18 ft. below the location of the injector. Under such conditions it would not be possible for the injector to create a partial vacuum in the supply pipe sufficient to permit the atmosphere acting upon the surface of the water, to force the water up to the injector.

This is so because when an injector is being started on a lift, the vacuum enabling the lift is created by the velocity of the steam through the tubes, the air in the suction chamber and supply pipe of the injector being exhausted by the friction caused by the jet of steam through it. At the pressure of 20 to 30 lb. this velocity is not high enough to create a vacuum that would permit water to rise above 10 ft.; therefore to raise the water 18 ft., other measures would have to be employed.

In such cases I have arranged an auxiliary tank with piping, as illustrated by Fig. 1. The auxiliary tank is represented by the letter F. A few gallons of water are placed in this tank for the purpose of giving the injector a start. When starting the injector, the valve controlling the flow from this tank is opened first, then the valve in the steam pipe is opened; the valve from the tank is then throttled until the injector begins to work. After the injector is started, open the valve in the main suction pipe leading to deep tank.

Water will rise from the deep tank and the cause of its rise is as follows: We have noted that the injector when working with but 20 to 30 lb. pressure could not give sufficient velocity to the steam to create by friction a partial vacuum high enough to permit the water to rise above 10 ft. When the injector has been started with the supply from the auxiliary tank, the vacuum in the injector is being created by the condensation of the steam by water. This causes a very much higher partial vacuum in the injector than could have been formed by friction. Since this vacuum caused by condensation is higher, its effect produces a greater rarity of air in the suction pipe to the deep tank and the water rises to the injector.

The valve controlling the supply of the auxiliary tank may now be closed and the injector will continue to work lifting its supply from the deep tank.

Water Supply Hot

PERFECT operation of an injector depends upon the temperature of the supply water. If the water is too hot it will not condense the steam rapidly enough for the injector to operate. Injectors are often wanted to take their supply from tanks which receive the condensation from exhaust of engines and from steam heating coils. The temperature of such supply often reaches 200 deg. F., which is too hot to do much condensing, and therefore injectors will not handle this supply.

Figure 2 illustrates an arrangement of tanks and piping for an injector when it is desired to use very hot water. The upper tank contains the hot water and the injector has a suction pipe into this tank. When starting the injector, open the steam valve, then open the valve in suction pipe to cold water tank about half way; when injector is started, open the valve to hot water tank gradually until a slight spill

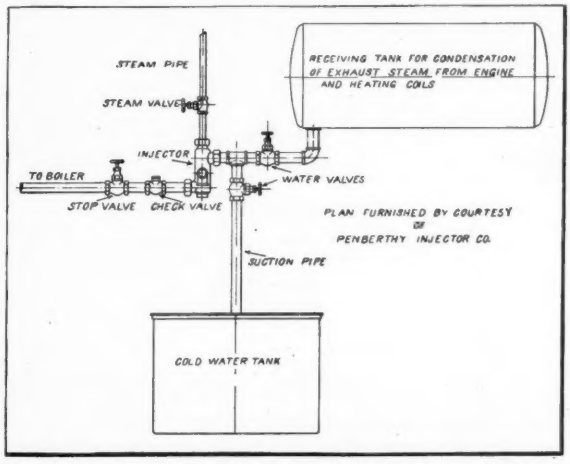


FIG. 2. PLAN FOR HANDLING VERY HOT WATER THROUGH AN INJECTOR

comes from the injector overflow. In this manner the hot water mixes with the cold, its temperature is reduced and the injector will work the hot water from the upper tank.

Overheating Supply on Traction Engines

CONSIDERABLE trouble has been experienced in operating injectors on traction engines, especially in cases where the engines have a steam siphon or ejector to lift the water into the engine tanks from wagon tanks, brooks or other sources, and from which engine tanks the injector is expected to deliver it to boiler. The siphon or ejector being operated with steam, the heat of the steam is imparted to the water, often adding to the temperature to such an extent as to render the injector inoperative.

Since on traction engines there are many different methods of arranging the injector piping, it is impossible to take advantage of any special piping plan that would aid the injector to handle the water from engine tanks in all cases. It is, therefore, necessary to make tubes of special form for the steam siphon. I aided the trouble caused by the heat added in the operation of the siphon, by constructing the tubes so that the work of siphoning would have to be done by the ejector entirely by lifting the water from below its position.

Ejectors or siphons are commonly made to work partially by lifting from below and partly by elevating above their position, but for traction engine uses it is not required that ejectors elevate greatly above their position, and the construction of tubes for ejectors, which permit the use of steam for elevating to great heights, is not necessary but harmful for such engines.

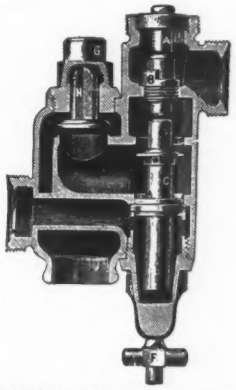
By constructing the tubes to work entirely by lift, a very small quantity of steam is required, merely sufficient to maintain a good partial vacuum, for having this vacuum it is obvious that the atmosphere pressing on the surface of water being siphoned, is doing the work of pushing the water up to the ejector and into tanks without the addition of much heat from the steam that the ejector uses. Therefore the water reaches the engine tanks quite cold and there is no trouble caused by the injector in delivering the water from the tanks into the boiler.

COMMERCIAL INJECTORS

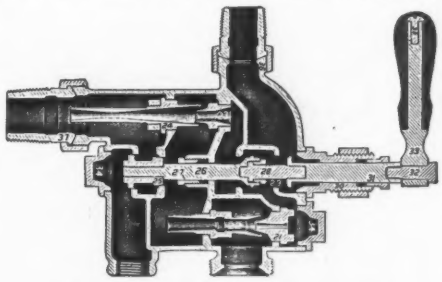
THERE is probably no class of machines where theory has been so closely adhered to as in the case of injectors, in fact since the invention of injectors the theoretical deductions never have been changed and the following descriptions of modern injectors and ejectors show that these appliances differ only in arrangement of tubes, valves and other mechanical conveniences without the least divergence from original principles.

U. S. AUTOMATIC AND WORLD DOUBLE TUBE INJECTORS

THE regular stock U. S. Automatic injector is adaptable to all around service, has a good efficiency, and is an excellent lifter, but may be used nonlifting by placing an extra globe valve in the suction pipe.



U. S. AUTOMATIC NONLIFTING INJECTOR



THE WORLD DOUBLE TUBE INJECTOR

The check valve is a straight lift; all parts are well designed and readily accessible.

The U. S. Automatic nonlifting injectors are designed to have the feed water supply flow to the injector, and, with the tank or barrel situated just above

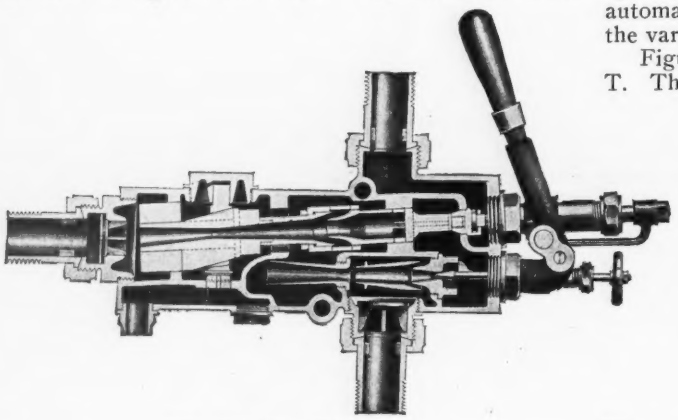
the level of the injector, it will start at from 1 to 3 lb. steam pressure. With water under 20 lb. pressure it has an operating range of from 10 to 180 lb.

The World injectors are shown in Fig 2. They are adapted for a wide range of temperature and pressure; the design is neat and compact; all parts are easily gotten at for repairs and cleaning. To start requires but the turning of one handle.

The American Injector Co., Detroit, Mich., is the maker of these injectors.

EYNON-KORTING COMPOUND INJECTOR

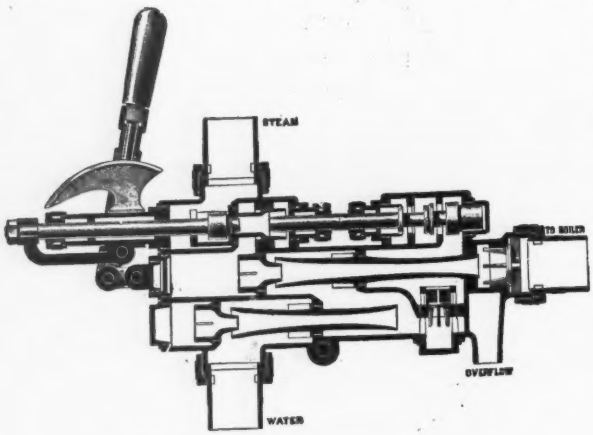
ONE handle is used to start, regulate and stop this injector and the construction is such that the suction and forcing nozzles can be readily taken out and particles of solid matter may be dislodged with wire without taking out the tubes. The overflow valves



THE NIAGARA INJECTOR

are of such design that they may be reground when necessary without disconnecting the injector from its piping.

In principle, the Eynon-Korting compound injector differs but little from the single instrument except that



EYNON-KORTING COMPOUND INJECTOR

there is a double set of nozzles and tubes, the first being to lift the water to the second which forces it to the boiler. By this arrangement the quantity of water delivered by the suction nozzle is in proportion to the steam pressure so that the first acts as a governor for the second.

The Niagara injector, also made by the Eynon-Evans Mfg. Co., is another form of double-tube type injector. In this type the forcing water and steam nozzles are connected directly with the spindle operated by the handle, and the overflow valve is vertical. Regulation is effected by a spindle with a knurled hand wheel governing the quantity of steam supplying the suction nozzle thereby regulating the amount of water delivered to the forcing nozzle.

METROPOLITAN INJECTORS

FIGURE 1 shows a section of a Model N Automatic Metropolitan Injector, operated by one handle, needing no regulating valve. The overflow valve is of the straight vertical lift type and is easily kept tight.

The vital point in an automatic injector is the opening between the steam jet and the suction jet. In the Metropolitan a large range in pressure is secured by using a sliding steam jet, with 2 metal seats, which automatically adjusts the size of this opening to suit the varying steam pressure.

Figure 2 discloses the Metropolitan Models O and T. These injectors are of the double tube type, and

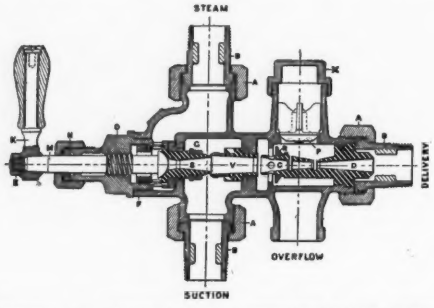


FIG. 1. MODEL N AUTOMATIC METROPOLITAN INJECTOR

replace the older model G. The horizontal line check valve has been replaced by a vertical lift check so constructed as to allow the injector to be removed for cleaning or repairs without removing the check valve from the pipe line.

These models are used extensively for high pressures, hot feed water and high lifts in both stationary and marine service. They are efficient and simple in operation, one lever controlling the action, although means are provided to regulate the steam supply to suit various pressure and quantity requirements.

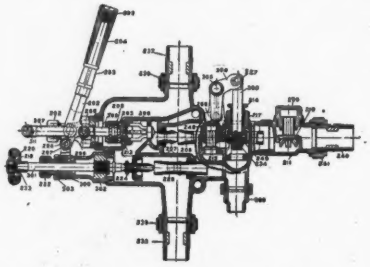


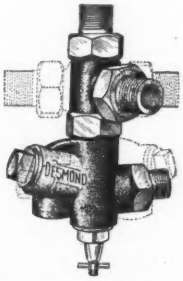
FIG. 2. SECTIONAL VIEW OF METROPOLITAN INJECTORS MODELS "O" AND "T"

In the model X, shown in Fig. 3, is seen one of the most modern instruments of this type. The action is automatic and is controlled by the globe valve in the steam line. This injector possesses a wide pressure range and is recommended for severe service such as on portable and traction engines. These injectors are products of the Hayden & Derby Mfg. Co.

DESMOND MODEL "U" INJECTOR

THE Desmond-Stephan Co. is the manufacturer of this injector, in which is incorporated distinctive and unique features. It operates with a high efficiency over the maximum range of pressures and temperatures. Its construction is such that it may be

FIG. 3. METROPOLITAN MODEL "X" AUTOMATIC INJECTOR



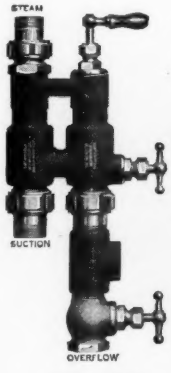
DESMOND MODEL "U" INJECTOR

turned to fit any side; the interposition of the union nut permits the injector connections being made at the most convenient angles and without necessitating change in piping. All connections are interchangeable with those of other leading upright injectors.

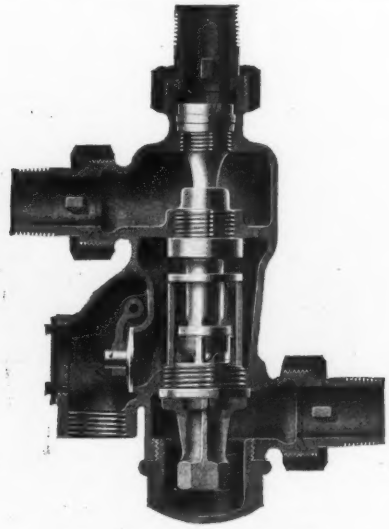
STATIONARY TYPE HANCOCK INSPIRATORS

THIS type of Hancock Inspirator is simple in construction and operation and is effective over a wide pressure range. It is claimed that no adjustment is needed with a varying pressure of from 25 to 250 lb., and that the instrument will handle hot or cold water with long lifts.

The operation is controlled by 3 self-contained valves making this inspirator particularly adaptable



HANCOCK STATIONARY TYPE INSPIRATOR

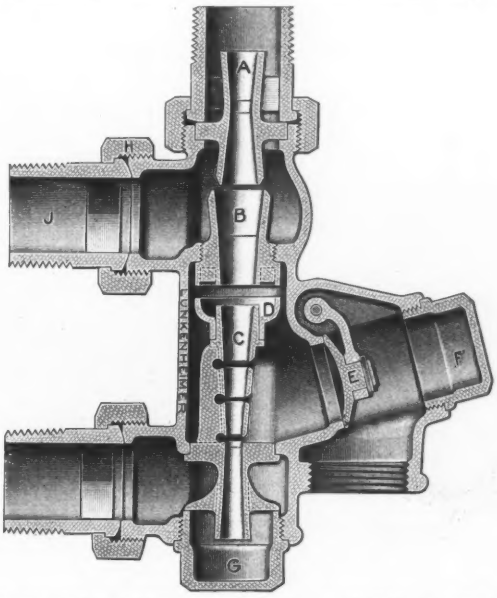


INTERIOR VIEW OF SELLERS RESTARTING INJECTOR

to service of a portable or semiportable nature, this service demanding simplicity combined with dependence. When not in use as an injector it may be used in raising water from one level to another, having a total lift, or elevation, of 137½ ft., or by using only the raising tubes, the forcing apparatus being idle, the instrument may be used as an ordinary ejector.

SELLERS' RESTARTING INJECTOR

WHILE retaining its original and special features, the sliding bushings of this injector have been replaced by a light brass ring. An external overflow valve has also been added. A screw thread is provided for attaching the delivery tube to the main body; furthermore, this injector may be used either right or left handed.



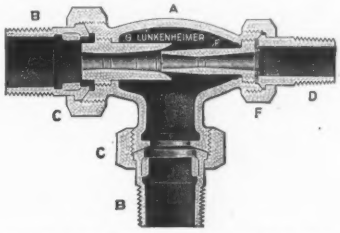
CROSS SECTION OF LUNKENHEIMER AUTOMATIC INJECTOR

Of the automatic type, it operates through a range including all probable conditions; instantly restarting after a temporary interruption. All joints are screwed, no tubes or joints depending on steam pressure to hold them in place.

The Sellers' restarting injector is furnished by Jenkins Bros., and may be had in all standard gages.

LUNKENHEIMER AUTOMATIC INJECTOR

IN this injector the combining tube is divided so that when steam is first turned on there is ample space for it to escape from the combining tube through the openings provided and the swing check valve E to overflow. As soon, however, as a stream of water is



THE LUNKENHEIMER EJECTOR

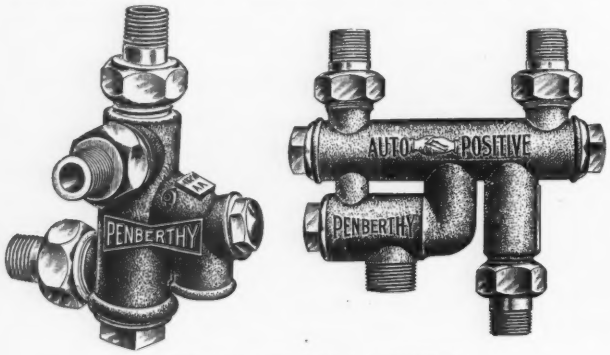
established the steam is immediately condensed, the valve E closes and water is forced through the delivery tube into the boiler. It will be seen therefore that this injector will start itself if at any time the supply of water be temporarily interrupted.

The tubes are made of hard bronze composition and are easily accessible for inspection and cleaning. Five styles of this injector are made to suit connections of various kinds.

The Lunkenheimer ejector is made for operating in a horizontal position and is designed to lift water 20 to 25 ft. according to steam pressure. The small sizes are made of brass while the larger ones are of iron, all unions being of brass. The tubes are made to screw into the body and the union connections make the ejector easily detachable.

PENBERTHY INJECTORS

PENBERTHY Automatic injector is a restarting machine capable of re-establishing the flow of water after it has once been interrupted for any cause, without the necessity of regulation. These injectors are designed to start on pressure as low as 20 to 22



PENBERTHY AUTOMATIC INJECTOR
PENBERTHY AUTO-POSITIVE INJECTOR

lb. and work as high as 165 lb. on a 3-ft. lift; and when working on 60 to 80 lb. pressure will lift water 20 to 23 ft.

Penberthy Auto-Positive injector is simple in construction, consisting of 5 working parts and is operated by a single globe valve in the water supply

PENBERTHY "XL-96" EJECTOR

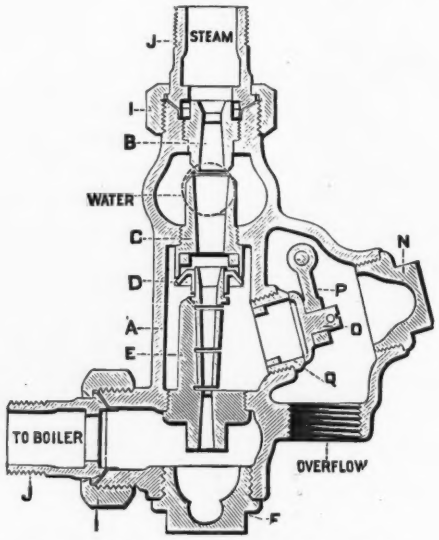
valve. By removing the plugs at the ends the tubes can be inspected or removed for cleaning without disturbing the connections. This injector, while automatic, also has combined with it the features of the positive type.

For elevating liquids in large quantities the Penberthy "X L-96" ejector has a wide field of usefulness, such as emptying fly-wheel pits, sump, flooded cellars, exhausting gases, air, priming centrifugal pumps, etc. It is capable of lifting water 20 to 25 ft. or elevating as high as 100 ft., with 80 to 100 lb. steam pressure by placing the ejector a foot or so from the water supply.

POWELL AUTOMATIC INJECTOR

THE design of the tubes and tapers in the Powell Automatic valve injector is such as to reduce scaling up of pin holes and other delicate parts to a minimum and guarantees a stronger and more certain action.

The overflow valve is of the swing type, the seat being constructed independent of the main casting which allows a ready replacing of this part in case such becomes necessary. In operation, the first steam and water is relieved through the space between the tubes D and C, and overflows through the check valve O. When sufficient pressure has been created in the delivery tube E, water enters the boiler, the flow through the tubes E causing a vacuum in the chamber A, which closes the check valve O. If the operation



THE POWELL AUTOMATIC INJECTOR

is interrupted, water is again forced out the overflow until a sufficient pressure is restored in the delivery tube.

THE LEADER INJECTOR

NEAT in appearance, efficient and simple in operation, the Leader injector adds to these qualities easy access to all parts for cleaning and repairs. A plug is located directly behind the steam lifting jet

REMOVING SCALE FROM THE LEADER INJECTOR

in which obstructions first occur, which may be removed by merely unscrewing, allowing ready cleaning of the jet. A special drill can be had from the manufacturers which removes all lime scaling from the forcing tubes in a few minutes without removing injector from the boiler.

After steam is turned into the lifting jet and water appears at the overflow, the remaining part of the operation is performed by simply throwing the lever which controls the forcer and the overflow. No movable parts are incorporated in the internal construc-

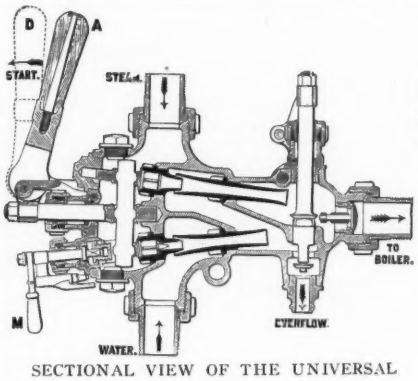
tion. The Leader can be used as a boiler feeder, scale solvent feeder and syphon or ejector. It is the product of the Randle Machinery Co.

UNIVERSAL DOUBLE TUBE INJECTOR

THIS injector is the combination of 2 jets, the lower designed for extreme suction and strong action. The discharge is into the upper jet where it receives the additional impulse to send it into the boiler. The pressure and volume of the lower jet correspond with the steam pressure which tends to keep proper relation in the upper jet.

These injectors are well made; all nozzles are fixed, and there are no slip joints. No adjustment is necessary and it is unaffected by jars and shocks.

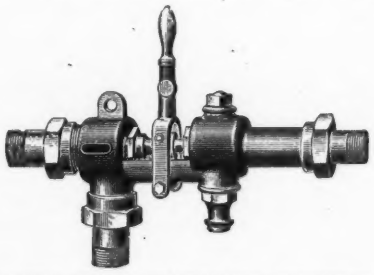
The entire operation is affected by one handle, which when brought into a vertical position admits steam to the lifting tube, and when wide open, admits steam to both tubes. Schutte & Koerting Co. is the maker.



SECTIONAL VIEW OF THE UNIVERSAL DOUBLE TUBE INJECTOR

LITTLE GIANT STATIONARY INJECTOR

THE special feature of this injector, made by the Rue Mfg. Co., is a movable combining tube operated by a lever which regulates the quantity of water for all conditions. The Little Giant is made of either the lifting or nonlifting type, the difference being that in the former type a lifter is placed in the water pipe with an independent jet which permits the use of ordinary valves. The quantity of water is regulated by the injector lever which must not be closed at either end while starting or working the injector.

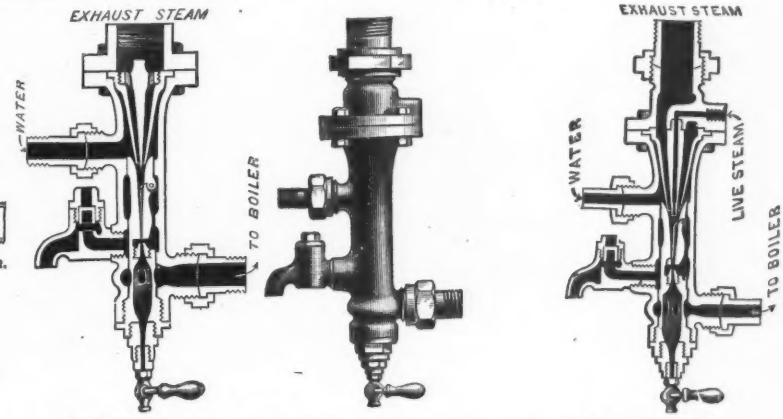


LITTLE GIANT STATIONARY INJECTOR

THE PATENT EXHAUST STEAM INJECTOR

THIS type injector is manufactured in 2 styles, Figs. 1 and 2, by The Schaeffer & Budenberg Mfg. Co. These injectors utilize the exhaust steam from any noncondensing engine, heating to about 190 deg. F., effecting an economy, it is claimed, of from 15 to 25 per cent in fuel and water.

Figure 1 illustrates an injector designed for service where exhaust steam supply is always ample. It will operate against 75 lb. boiler pressure. In Fig. 2 is shown the injector arranged with a live steam auxiliary tube inside the exhaust steam tube. Its purpose is two-fold; if the exhaust supply is temporarily insufficient, a little live steam is added; or, if pressures above 75 lb. are carried, the live steam jet adds the extra energy to force the water into the boiler. It operates against pressures up to 150 lb. gage. In this injector, the live steam does not meet the water until the exhaust steam has completed its function, thereby maintaining maximum economy.

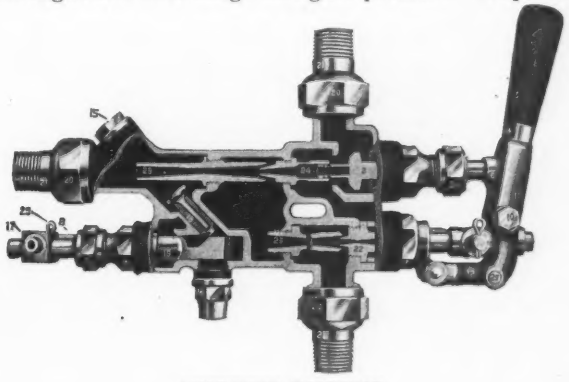


SCHAEFFER AND BUDENBERG PATENT EXHAUST STEAM INJECTOR

FIG. 1. PLAIN FIG. 2. WITH LIVE STEAM AUXILIARY FOR HIGH PRESSURES

THE SHERWOOD INJECTOR

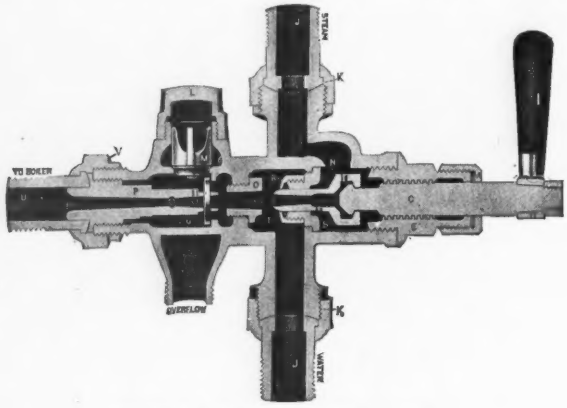
THE Sherwood Manufacturing Co. is the maker of both the Sherwood and the Buffalo automatic injectors. The first mentioned is of the double-tube type, designed for all conditions of high pressure and lift. It is claimed that it is especially adaptable where it is desirable that the injector have good lifting capacity at a low pressure and be equally efficient throughout a wide range of higher pressure. A special effort has been made in the design to facilitate cleaning and repairs.



SHERWOOD INJECTOR

The Buffalo automatic injector is shown in Fig. 2. It combines all the qualities possessed by injectors of this type, and a wide range of working without adjustment; it can easily be graded to meet the require-

ments making the feed continuous and results economical. And as with the double-tube type, working

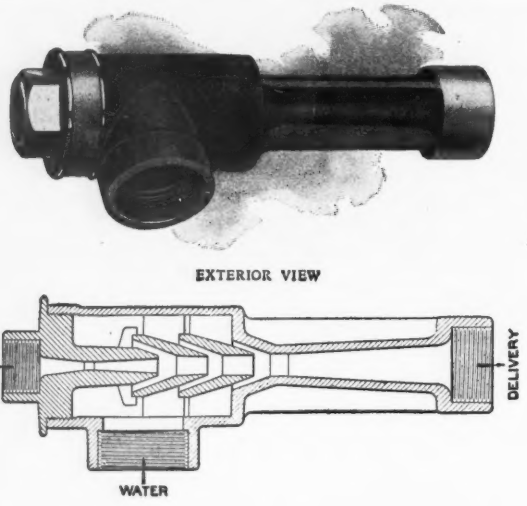


BUFFALO AUTOMATIC INJECTOR

operations are confined to the use of but one lever or handle.

NATHAN EJECTOR

AS a means for raising water from deep wells, filling tanks, temporary drains, etc., the ejector finds its greatest use. The Nathan ejector, made by the Nathan Manufacturing Co., is of a special steam metal which does not rust. All parts being fixed, no adjustment is necessary. Water is received through several nozzles



EXTERIOR VIEW

INTERIOR VIEW

THE NATHAN EJECTOR

instead of one, which is claimed to give a low steam consumption. To operate, it is only necessary to turn off or on the steam supply.

"NEVER FORGET that it's those seemingly superfluous efforts that count; the work that you do for the love of working, not what you do within working hours and merely because you are paid for it."

"SMILE AND you fool many—scowl and you only make a fool of yourself."

HOW SOME STEAM HEATING PLANTS ARE INSTALLED

BY F. D. KIRBY

RECENTLY, the writer superintended some building construction on one of the western railroads. On one building in particular there had been considerable trouble in getting the plans and specifications followed closely. The company had had 2 different men on the work, with no better results. When I took charge of the work, there was quite a mixup between the contractor and subcontractors and the railroad. The work was about 70 per cent complete.

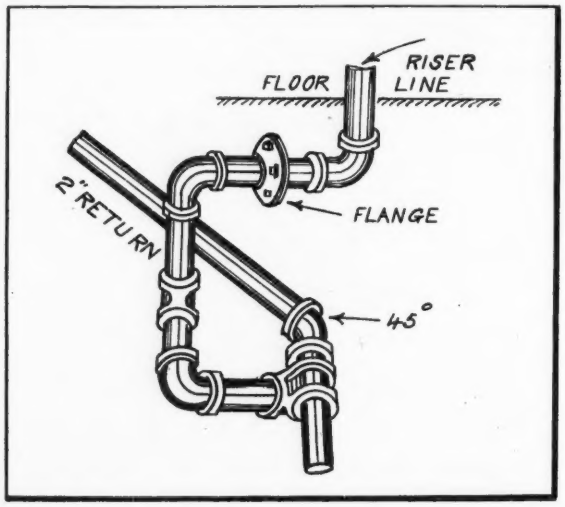


FIG. 1. CORNER CONNECTION IN CONCRETE CONDUIT FROM MAIN WAITING ROOM

The entire building came in for its share of criticism. The millwork was not in accordance with the contract; the plumbing, supposed to be the Durham system, was far from being so. In fact the work as a whole showed lack of superintendence. The plans were drawn for an over-head system of steam heat with gravity return. Both the plans and specifications were well gotten up. The contract was let to a firm who had been in business about 25 years.

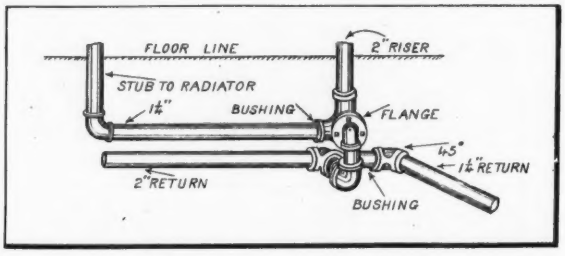


FIG. 2. CONNECTION BY STUB UNDER FLOOR TO RADIATOR FROM CONDUIT TO WAITING ROOM

Drawings showed pipe lines, radiators, etc., everything where it should be and in some cases illustrated by details, yet they were not followed. The return was to be encased in concrete conduit about 12 by 12 in. along the outside wall of the building, this to have a concrete top and covered with tile and marble floor, the pipe lines in this conduit to have rollers.

All work was said to be completed when it was turned over to the writer. After investigation it

showed that it was not only not completed, but if left as installed it would never have had complete circulation. The work was ordered torn out, or opened so that it could be investigated. The company advised the contractors to get the work in shape and they put in a lot of time on the job but failed in any way to complete work as it was installed. After repeated efforts on the part of the company and the contractors to have me pass the work, the company concluded to hire a heating engineer to look the work over with the writer, the result being that the work was ordered torn out.

After considerable discussion a central heating plant was decided on, located about 2500 ft. from the depot, the building in question, this plant to have the capacity of about 15,000 sq. ft. of radiation. A vacuum system was installed in all the buildings. The depot carried 4500 sq. ft. of radiation.

In tearing out the work as first installed, so many different ways of how the work was done were noticed, that the writer made free-hand sketches on the job. The different runs of pipe were from a few feet to about 80 ft. no expansion was allowed at any point,

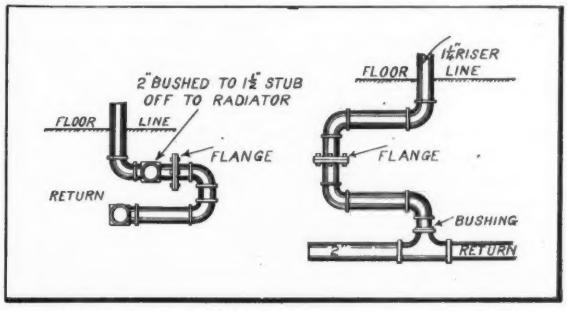


FIG. 3. TYPICAL CONNECTIONS, RISER TO RETURN

everything a stiff connection. I don't know what the heating contractor had in mind when he installed the work. Of course a job is better off without a lot of expansion joints, but at times it is necessary.

Sketch shown in Fig.1 illustrates a corner connection for a riser to the return in the conduit, there were two like this. Figure 2 shows another connection to return, with the stub under floor to radiator; two of these were on the first floor. Figure 3 shows typical connections made for risers entering the return, these were made on a slight angle to allow for swing, but why so much material used in connecting a riser and return, is what they failed to explain. Figure 4 shows the connection found above plaster in the ceiling of the first floor. Note where the flange is located, below this was a half beam cornice next to the wall. A typical connection in the attic from the main to the risers is shown in Fig. 5.

All these were stiff connections, pipe line for risers extended about 20 ft. from the main across. Note that this connection Fig. 5, shows a 1¼-in. off the main taking care of a 2-in. riser. This was found in a number of cases. Bushings were used plentifully, not only in the pipe line, but in what radiators they had installed. All flanges were shown on the plans to be in the attic, all connections to main and risers to have swing joint. Note the location of the flanges and how connections to main were made. All these changes were made and the company paid the cost.

You wonder why this was allowed. Lack of superintendence was the reason. When the chief engineer makes a statement that he can get all the superintendents or, by their official title, inspectors, for 50 to 75 dollars a month, the answer is plain enough. It seems strange that a railroad company looks on the side of more men for the same money than a few men of experience at a higher salary. Cheap labor is a big item to them, that and the "official title" made up the pay-rolls and not ability and experience. This is shown in a number of cases. At the power house there was enough steam escaping from poor connections and overworked boilers to heat, with the exhaust steam, all the buildings located at this point.

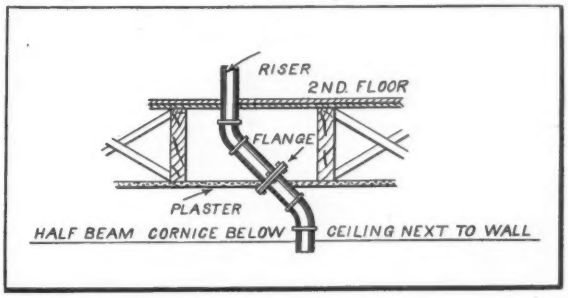


FIG. 4. SECTION THROUGH SECOND FLOOR

Not only that, but the amount spent for oil in one year would go close to buying a new boiler.

System and increased efficiency are as much needed as rate increase. The statement recently made by a lawyer that the railroads could save a million dollars a day may be a little broad, but considerable difference could be made in operation and maintenance. They are willing to pay when conditions are

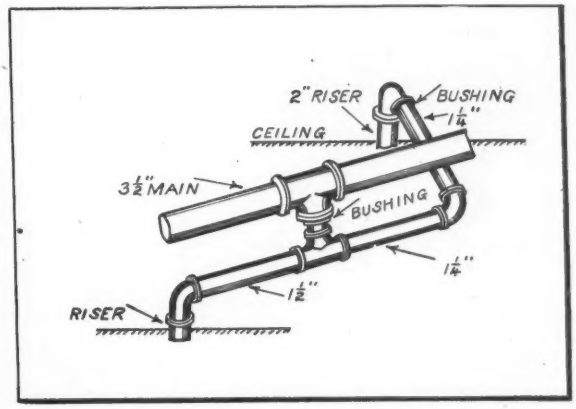
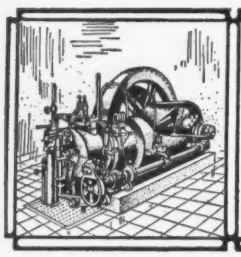


FIG. 5. TYPICAL CONNECTION OF MAIN AND RISERS IN ATTIC

such that they have to do so, but it is a case of spending a dollar to save a nickel. The cost of all the work done at this one location could have been reduced between 10 and 15 thousand dollars, by the use of a little judgment. Not on this one buildng and plant, but on the whole amount expended at this division point in buildings, etc.

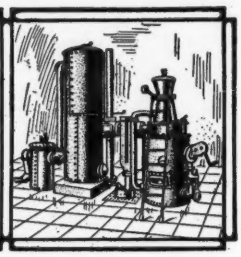
FIRE LOSSES for the first six months of 1911 were $129,691,750, as against $99,228,900 for the same period last year. If this burning ratio continues, the loss for 1911 will be over $260,000,000. Last year the bulk of the losses came in the last six months.

MARK TODAY as an epoch in your life and as the beginning of a realization of your ambition.—Mahin Messenger.



Gas Power Apparatus

Producers, Engines and Industrial Applications



MASTERING THE GAS ENGINE

CORRECT SETTING OF VALES FOR SMALL ENGINES; HOW TO GO ABOUT IT TO GET BEST RESULTS

By C. F. Swingle

IN a former article, the 4 acts in the 4-stroke cycle of a gas engine as 1, induction; 2, compression; 3, explosion; 4, expulsion, were explained.

Usually the valves that control the admission of gas and air during the act of induction are adjusted so that the first portion of the induced charge is air

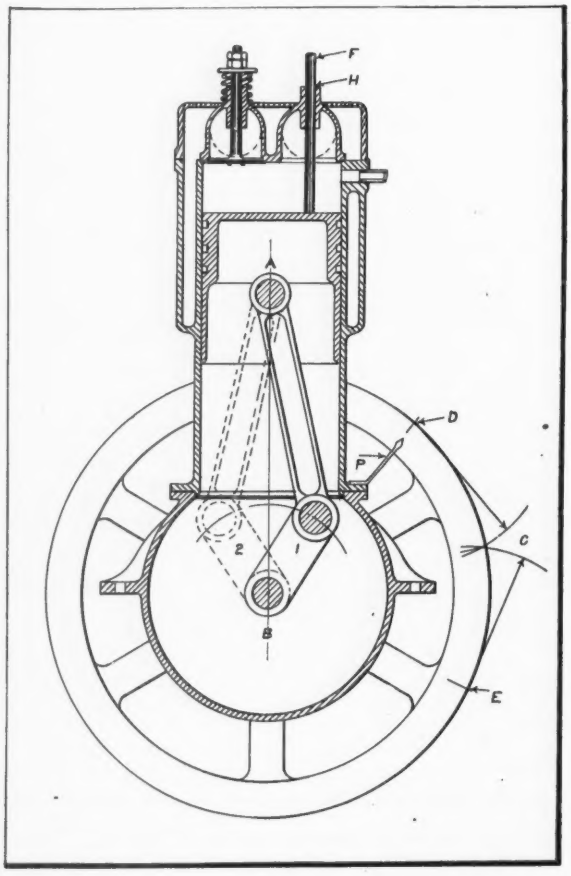


FIG. I. SECTION OF SMALL, VERTICAL, HIGH-SPEED GAS ENGINE

only, next air and gas, and finally air with only the small quantity of gas carried in by the moving current of air from the passage ways connecting the gas and air valve seats.

Timing Admission

THE main object to be attained is so to arranged the timing of the valves as to insure a well mixed charge. With this end in view some builders set the valves so that the gas valve is near its maximum lift by the time that the air valve has started to open. This plan of adjustment is based upon the theory that there is no suction created until the opening of the air valve takes place.

The cams operating the valves should be so designed as to produce maximum lift quickly; but, the actual opening, and closing of the valves should be gradual in order to be in accordance with the induced velocity caused by the linear speed of the piston at the various points of the stroke.

In order to utilize fully the effect of the momentum imparted to the entering gases at the highest rate of piston speed, the air valve controlling the entry of the entire charge should be opened well in advance of the inner dead center of the engine, and kept from closing until after the piston has passed the outer dead center, thus making it possible to complete the filling of the cylinder with the explosive mixture which is to be compressed during the following in stroke of the piston.

Compression

MAXIMUM pressure to which the mixture of air and gas that is entrapped in the cylinder by the closure of the admission valve may be compressed during the in stroke of the piston depends entirely upon the quality of the mixture, that is the relative proportions of hydrocarbon gases and hydrogen contained in it.

If the ignition temperature of the mixture is low, owing to the presence of a large percentage of hydrogen, there is a possiblity of self-ignition due to additional heat of compression, therefore, with illuminating gas as fuel, the maximum compression pressure is placed at 120 lb. per sq. in., unless provision has been made for the injection of cold water, or cold air around the clearance spaces and valve seats during compression.

If producer gas is to be used, pressures of 150 to 200 lb. per sq. in. may be obtained with safety, while with blast furnace gas containing only about 2 per cent of hydrogen, a compression pressure of 200 lb. per sq. in. or over may be safely carried. The higher the compression pressure, consistent with safety and freedom from self-ignition the more economical will the engine be.

Admission of the explosive mixture to the cylinder, its compression, and the final exhaust of the expanded gases, being each and all controlled by valves, it nat-

urally follows that the setting of these valves so that the above mentioned events will occur at the proper times, is a matter of as much importance with the gas engine as is the setting of the valves on a steam engine.

Locating the Dead Center

THE first step in the process of valve timing is to locate the dead centers. It should be remembered that although the piston is at the extreme end of its stroke when the crank is at dead center, still it is impossible to determine accurately when dead center is reached by merely watching the position of the piston. This is due to the fact that the crank pin may move a certain number of degrees on each side of the center without any perceptible movement of the piston taking place. The following method applies more particularly to the smaller size, high speed engines. Large engines will be discussed later on.

Figure 1 shows a vertical section of a small, high speed gas engine, having the valves in the cylinder head. At P is shown a pointer permanently bolted to the engine frame in such a manner as to come close to the face of the flywheel, which latter it is presumed is securely keyed to the crank shaft. The piston is shown near the top end of its stroke, the full lines showing the crank and connecting rod approaching the center line A B.

With the working parts in this position, remove one of the valves and insert a rod F through the hole in the head and let it rest firmly on top of the piston. Rod F should be of such diameter as to slide easily in the valve stem guide, although not so loose as to tip.

When the valves are not in the head, a spark plug or igniter may be removed, and a wood block fitted into the opening and a guide hole drilled through it for rod F.

Having thus arranged all the preliminaries, and with the crank in the position designated as position 1, take a steel scriber and make a mark on the rim of the flywheel at D in line with the pointer P, also make a mark H on rod F at the top of its guide. Next turn the crank slowly to the other side of the center designated as position 2, and when mark H on rod F is at the same position relative to its guide and to the piston as it was before, the crank will be at exactly the same distance from the center as it was when at position 1.

Now mark the face of the flywheel at E as indicated by pointer P. Marks D and E are now at equal distances on each side of the center and the next move is to bisect the distance from D to E as shown, and bring the central mark C to the fixed pointer P, which will bring the crankpin to the exact dead center for that end of the stroke.

The bottom center is located by the same method. It is a good plan to leave pointer P permanently in position for future use.

Timing the Valves

HAVING succeeded in locating the dead center it is next in order to time the valves. The factors which decide the best valve setting for any particular engine are: Valve lift; size and length of inlet and exhaust passages; and piston speed.

If the speed of the engine is slow and the inlet valve and passageways are of ample size, excellent results may be obtained by timing the inlet valve to open and close at dead center, or 10 deg. after center, and the exhaust opening may be fixed at 15 to 20 deg. before center.

By the term 'degrees before or after center,' is meant that the movement of the valve is to take place when the crank has reached the specified number of degrees before or after center as the case may be.

If the speed of the engine be high, and the incoming charge enters the cylinder at a high speed, a later closing of the inlet valve is necessary owing to the higher vacuum following the piston and the inertia of the incoming charge. Better action of the carbureter will be secured by a late opening of the intake valve, as for instance when the crank is from 10 to 20 deg. past center.

On very high speed engines the closing of the inlet valve should not occur until 30 or 40 deg. past center has been reached.

On the exhaust or scavenging stroke the exhaust valve should never be allowed to close before the crank has reached center.

On the power stroke the exhaust valve should open at from 15 to 40 deg. before center, depending upon the size and speed of the engine, the higher speeds requiring the earlier opening, while with slow-moving

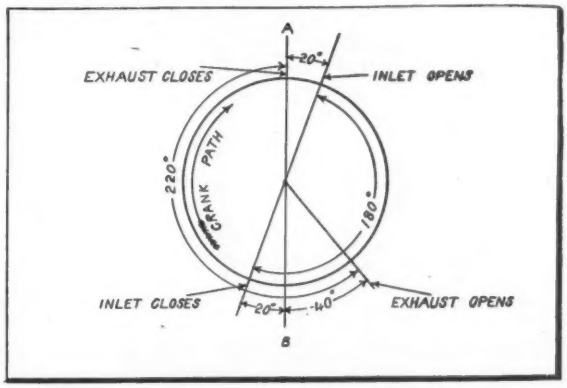


FIG. 2. DIAGRAM OF CRANK POSITIONS FOR VALVE OPENING AND CLOSING IN SMALL COMBUSTION ENGINES

engines the exhaust opening may be delayed to within 15 to 20 deg. before center.

Figure 2 shows the different points in the crank's path where these valve events occur. The line A B is the dead center line; otherwise the cut is self-explanatory. The method by which the number of degrees from dead center at which the valves open and close is determined, is very simple, as for instance, assume exhaust valve opening to occur at a point 10 in. (as measured on the face of the flywheel) before the crank reaches dead center on the power stroke of the piston. As there are always 360 deg. in every circle, the first step will be to ascertain the number of inches, or feet in the circumference of the wheel.

In this case we will assume the wheel to be 36 in. in diameter, then $36 \times 3.1416 = 113.09$ in., circumference of the wheel. Next find the number of degrees per inch as follows: $360 \div 113.09 = 3.17$ deg. for each linear inch on the face of the wheel; and as the wheel face must still travel 10 in. to reach center we have $3.17 \times 10 = 31.7$ deg. before dead center on the power stroke as the point of opening for the exhaust valve.

The point of exhaust closure, and the movement of the inlet valve (provided it is operated with a cam and gear) can be determined by the same method.

It should be borne in mind that the opening time of a valve cannot be changed without making a corresponding change earlier or later in the closing time also, unless a new cam of different design is used.

KNIGHT SLIDE VALVE MOTOR

IT has been, for some time, the consensus of opinion that the poppet valve type of combustion engines has realized its limit of perfection, and for several years past, automobile, and kindred interests, have been anxiously awaiting the appearance of a new, and proven successor.

With interest we note the announcement of the Columbia Car Co., that it will introduce a new car, whose power plant will consist of the Knight slide-valve motor, which, for 2 years, has been highly successful in several of the best foreign cars.

The engine is a distinct Columbia production, having been designed and developed during the last 2 years by the engineering staff of the Columbia Co., who in conference with Mr. Knight, have received the benefits of the inventor's experience.

It is of the 4-stroke type, cylinders, 4⅞ by 5⅛ in., cast in pairs, with an A. L. A. M. rating of 38 hp., it is said to deliver 70 hp. normally, and 85 hp. with motor running at its greatest speed.

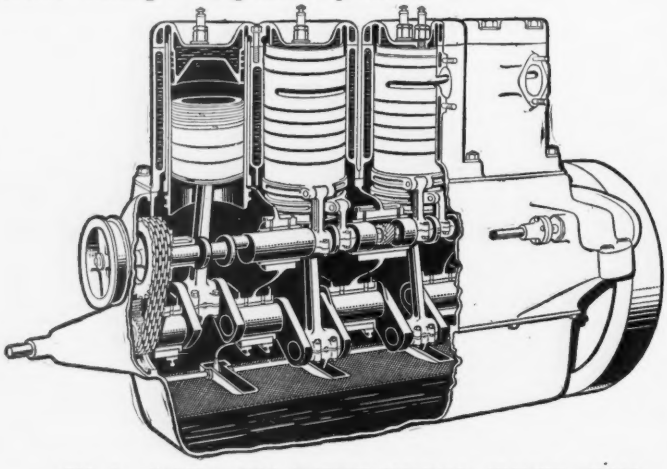


FIG. 1. PARTIAL SIDE SECTION COLUMBIA KNIGHT MOTOR

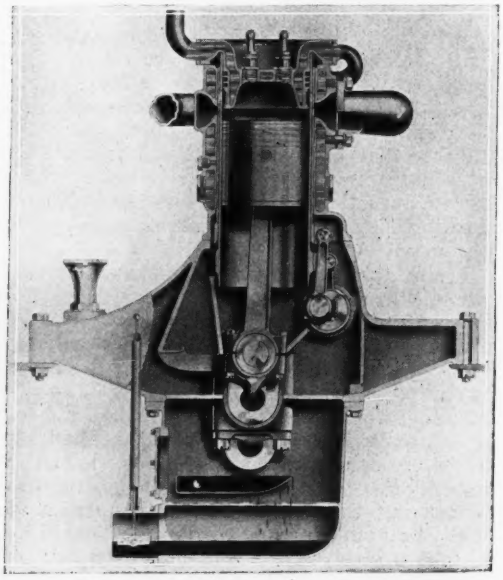


FIG. 2. END SECTION, COLUMBIA KNIGHT MOTOR

The cylinder heads are depressed, bolted on, and arranged for the double Bosch system of ignition. Water circulation is provided throughout the head and cylinder, maintaining a uniform temperature the length of the piston travel and above it.

The valve arrangement consists of 2 sleeves, one sliding within the other, and situated in the bore of the cylinder. Inside the inner sleeve is the piston. The sleeves are operated by connecting rods, attached at the lower ends, and actuated from a small crank shaft, driven at ½ speed from the main shaft by a silent chain drive.

On either side of each sleeve near the top, is a long, wide slot, one communicating with the admission part, the other with the exhaust. Their relative positions are such that during the admission stroke the slots on that side are coincident, giving entrance to the gas. On the compression and firing strokes, the slots do not register, but as the exhaust stroke begins, the 2 slots on the exhaust side meet, allowing a free escape of the gases. At the end of the stroke the slots have again closed, and the 2 on the admission side just begin to open. The engine has, therefore, gone through one complete operation of the 4-cycle principle.

The advantages of this motor are, first, that the inlet and outlet passages are of twice the area of any on the most liberally designed poppet valve machine.

There is a perfect timing of the valves.

No offset pockets exist so that the smallest possible space exists for the compression of the gas.

The sleeves, rings, pistons, and cylinders are made of the best Swedish grey iron, and are cast abroad. All mushroom valves, cams, cam shafts and rollers, springs, and gear trains are eliminated which not only reduces the moving parts by one-third, but tends to produce a very noiseless motor.

The lubricating system of this motor is worthy of note, its endeavor being to furnish lubrication proportionate to the work. The connecting rod dips into a trough of oil, the trough being situated on a rod actuated by the movement of the throttle. As the throttle is opened, the trough is at the same time raised, the connecting rod dips deep into the oil and carries the maximum amount to the wearing surfaces. When the throttle is partly closed, the trough is lowered preventing the rod from dipping deeply, thus lessinging the supply of oil carried to the various parts. It is claimed that a single gallon of lubricating oil will suffice for a run of 750 miles; in fact, on one occasion it was not replenished during a trip of 1200 miles.

GAS ENGINE PERFORMANCE

IN a paper entitled, "Boosting the Gas Engine Business," before the National Gas and Gasoline Engine Trades Ass'n., Albert Stritmaller gave some interesting data in regard to performances of internal combustion engines. One of these was in regard to the engine of the motor lighter, Crudoleo, which left Havana, Cuba, at 7 o'clock on the 22nd of December, and arrived at Port of Spain, a run of 2100 miles, at 5 o'clock on January 14th, the voyage occupying 23½ days a considerable part of the time against a gale which was so rough that no progress was made for several hours. The engine worked excellently the whole time until the 22nd day, when it began to slacken by reason of dirt collecting in the suction pipes from the oil tank. The destination was attained with both engine and boat in very good condition. This makes a 22-day non-stop run, under trying conditions.

ATLAS DIESEL TYPE CRUDE OIL ENGINE

ATTENTION of power users is being directed at present toward the new Diesel type oil engine developed by the Atlas Engine Co., of Indianapolis. In tests conducted by C. E. Sargent, of Chicago, on a 2-cylinder engine, direct connected to a 175-kw. generator, an absolute efficiency of 30 per cent, based on brake horsepower, was obtained. Comparing this with the best steam engine performance of from 20 to 22 per cent, the remarkable economy of the engine becomes apparent.

Operation

THE Otto, or 4-cycle principle, is employed. Fuel is either crude oil or fuel oil. The first stroke draws in a charge of air alone, which is compressed to about 500 lb. on the return stroke. At the end of this stroke, fuel is sprayed into the cylinder by an air jet of 900 lb. pressure, which ignites upon encountering the highly compressed air already in the cylinder, the temperature of the latter being about 1000 deg. F. Very rapid combustion, but not explosion, takes place while the fuel is being injected, and during which time the hot gases expand at constant pressure. When the fuel supply ceases, the further expansion of the gases continues until the exhaust valve opens.

Starting is accomplished by admitting compressed air, at 900 lb. pressure, to one of the cylinders, driving the engine for several revolutions, in which time a charge of air has been drawn in and compressed in the other cylinder producing a temperature high enough to ignite the jet of fuel oil. Reservoirs and a compressor are supplied to furnish the air.

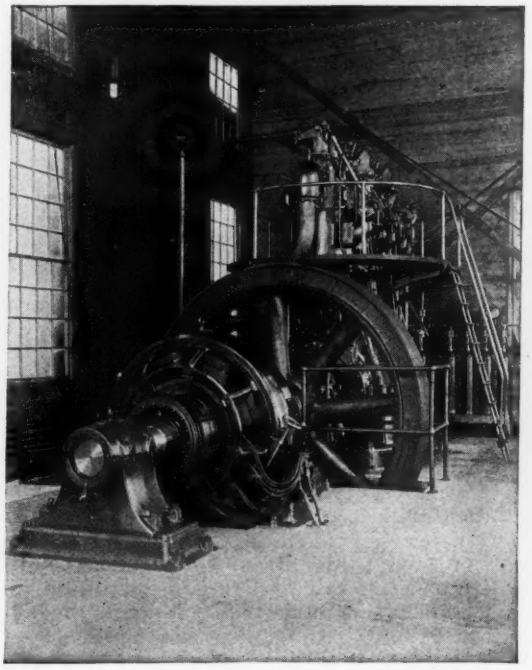


FIG. 1. ATLAS DIESEL TYPE CRUDE OIL ENGINE DIRECT CONNECTED TO GENERATOR

The governor, operated directly from the main shaft, regulates the amount of fuel admitted to the cylinders, by measuring the amount admitted to the first stage of a 2-stage fuel injection pump. From no load to full load, the speed does not vary over 3 per cent, which makes the engine suitable for driving electrical generators.

General Description of the Engine

THE Atlas Diesel Type Crude Oil Engine is of the vertical, single acting, enclosed type. The base under each series of cylinders, is a separate casting,

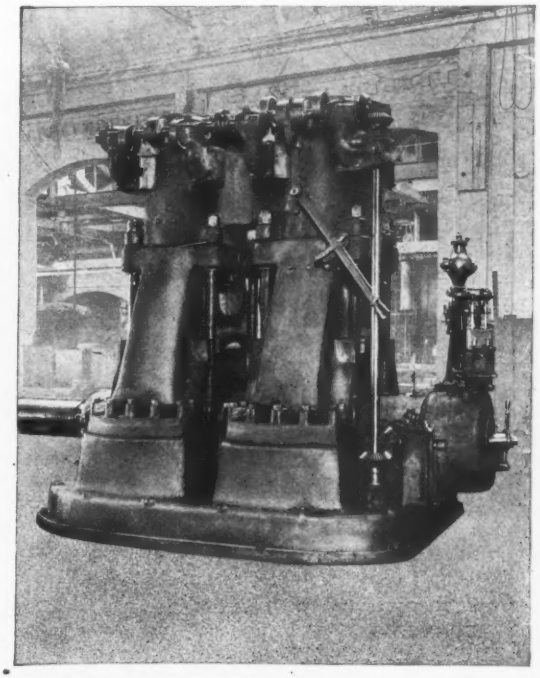


FIG. 2. TWO CYLINDER ENGINE PARTIALLY ERECTED

contains the housings for the main shaft bearings, and forms a suitable reservoir for the lubricating oil.

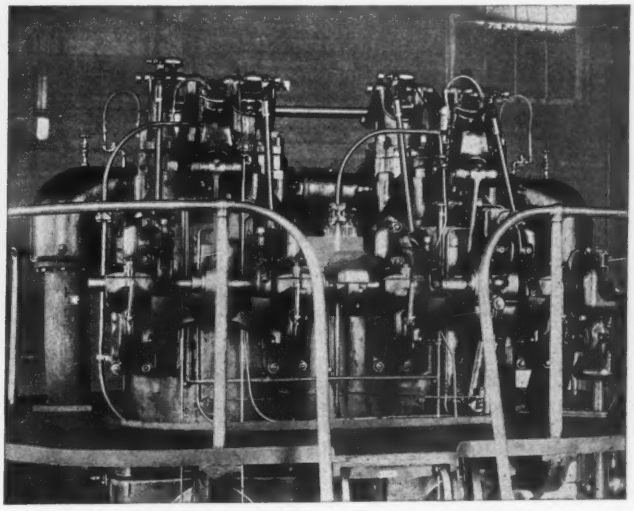


FIG. 4. VALVE MECHANISM AND GALLERY

The "A" frame over each crank is cast in one piece with the cylinder and water jacket and is of large proportions. Stresses in the cylinder are transmitted directly to the base by 4 heavy steel rods, run-

ning directly from the cylinder base to heavy anchorages in the base. Removable oil shields, allow easy access to the cranks, wrist pins, etc.

Bearings

ALL main bearings are halved, split horizontally. Anti-friction metal, hammered into anchorages, and suitably grooved for oil passages form the lining. Each bearing is fitted with 2 ring oilers running in a movable saddle or reservoir box filled by the splash from the crank case.

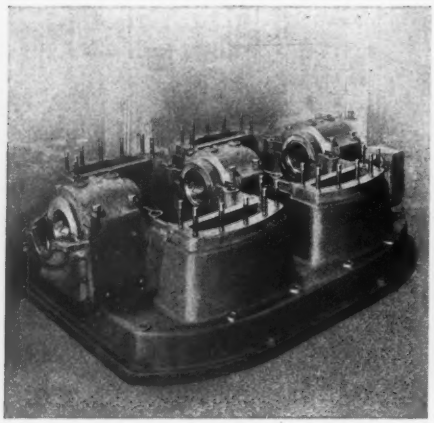


FIG. 3. ENGINE BASE SHOWING MAIN BEARINGS

Cylinders

INSIDE walls of every cylinder are formed by liners of special charcoal iron, suited to withstand the effects of temperature changes. Water jacketing is ample and circulation unimpeded. Cylinder heads are deep, heavy, and water jacketed, and a metal to metal joint is made between each cylinder and its head. All valves are attached to the head and need not be disturbed when the head is removed. A relief valve is so situated in this cylinder that its removal allows ample access for cylinder inspection without removing the cylinder head. Pistons are of the long trunk type, fitted with 7 rings. A hardened steel wrist pin is ground to a perfect surface and firmly secured to the piston.

Date Of Run	6-21-11	6-20-11	6-20-11	6-19-11	6-21-11	6-20-11	6-21-11
Duration Of Test In Hours	1	1.5	3	2	8.5	4	1
Load In K.W. Hours By Switch Board Meter	67	83.3	132.	173.5	200.4	205.75	249.
K.W. To Compressor By Watt-Meter	24.75	22.66	25.6	25.5	29.6	29.25	31.
Transmission Losses To Compressor 23.6%	5.84	5.34	5.5	6	6.98	6.91	7.31
Net K.W. Used By Compressor	18.91	17.32	19.1	19.5	22.62	22.35	23.69
B.H.P. Used By Compressor	25.32	23.20	24.25	26.13	30.31	29.94	31.74
Net K.W. Delivered To Line	48.09	65.98	113.9	154.	177.78	183.4	225.31
Net E.H.P.	64.44	88.41	152.68	206.36	238.22	245.75	301.91
Generator Eff. % Manufacturers Rating	87	88.	88.	90.	91.	91.3	91.
Net B.H.P.	74.	100.4	171.4	229.2	261.7	269.4	331.7
Rev. Of Engine Per Min.	174.7	174.1	173.15	173.1	172.8	171.9	171.
Fuel Oil Used Lbs. Per Hr.	50.	61.3	81	108.	120.4	128.	167.
Pounds Oil Per K.W. Hour	1.04	.95	.71	.7	.68	.7	.74
Gal. Oil Per 100 K.W. Hours	14.22	12.75	9.75	9.6	9.27	9.55	10.15
Pounds Of Oil Per B.H.P. Hour	.67	.61	.472	.47	.46	.476	.503
Gal. Of Oil Per 100 B.H.P. Hours	9.18	8.36	6.47	6.44	6.3	6.51	6.9
B.T.U. Per B.H.P. Hour	12829.	11680.	9038.	9000.	8808.	9115.	9632.
Thermal Efficiency Of Engine B.T.U. Per D.H.P.	19.8	21.7	28.15	28.27	28.9	28.	26.4
Fuel Cost Of 100 K.W. Hrs. In Cts. Oil At 2 Cents Per Gal.	28.44	25.46	19.46	19.2	18.54	19.1	20.3

FIG. 5. SUMMARY OF TESTS

Valves

ADMISSION, exhaust and fuel valves have positive drives. Both admission and exhaust valves work in removable cages in the cylinder heads, are driven through eccentrics from the lay shaft and are readily accessible for adjustment. The fuel valves are actuated by cams on the lay shaft.

Lubrication and Air Supply

THE fan-tail cranks dip into the reservoir of oil in the crank cases, splashing it to the walls of the cylinders, wrist pins and main shaft bearings. Pockets or funnels assist in catching the oil and conveying it to the crank and wrist pins.

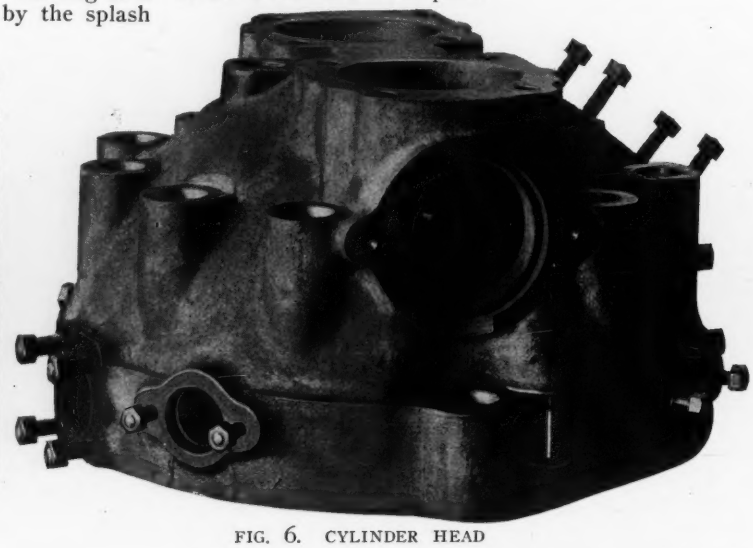


FIG. 6. CYLINDER HEAD

A set of steel air bottles or reservoirs, automatically charged by a 3-stage compressor, supplies the air at 900 lb. pressure for starting and injecting the fuel.

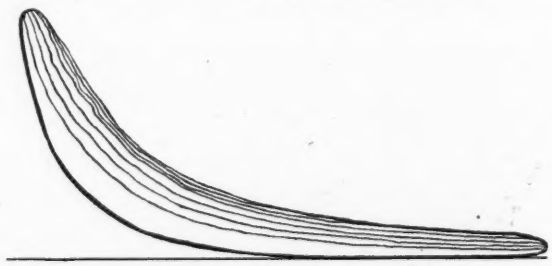


FIG. 7. INDICATOR CARD TAKEN AS LOAD WAS RAPIDLY REDUCED FROM FULL LOAD TO FRICTION LOAD

These bottles are divided into 2 sections, one section always being held in reserve.

Tests

HEREWITH is shown the summary of tests, the result of 7 runs of from 1 to 4 hr. each, from the lightest loads to the heaviest the generator could carry without overheating. The engine under test was of the 2-cylinder type, cylinders 20 in. diameter; 30-in. stroke. Generator, 250 volts, 700 amp., direct connected to engine. Fuel used, fuel oil.

It is interesting to note the good regulation expressed in the r.p.m. line as each figure is compared with the corresponding net brake horsepower in the line above.

In the pounds of oil consumed per kilowatt hour, the lowest amount was recorded at a point below the rated brake horsepower of the engine. This same effect, of course, is noted in the B.t.u. per brake horsepower hr. line. The last 2 lines record some surprising values; in column 5, the cost per 100 kw. hr. is 18.54 cents or less than 1-5 of a cent per kw. hr.

ECONOMY IN AIR COMPRESSION

MECHANICAL FEATURES

By L. I. Wightman

COMING now to consideration of the third element in air compression, the mechanical structure, we find it has an important bearing upon the economy and the endurance of the machine.

Mechanical efficiency of a compressor can be exactly determined in a steam-driven machine by a comparison of the steam and air indicator cards, or in a power-driven machine by comparing the measured power applied with the horsepower of the air indicator card. The difference between these values represents the power consumed in the friction of the compressor. Good mechanical efficiency, therefore, depends upon the extent to which friction is reduced.

Power should be applied to resistance—steam pressure to air pressure—in as direct a manner as possible, so that, as far as possible, bending or deflecting strains, with the resultant binding of bearings and loss of correct alignment, may be avoided.

Ample metal should be used, properly disposed to afford the rigidity necessary, as a further precaution against the attendant binding stresses just mentioned. Light construction is always to be avoided.

To avoid excessive weight and extravagant cost, materials should be of the best quality and intelligently selected for specific purposes, affording the maximum strength per unit of weight.

All bearings should be of ample area, so proportioned as to give a safe, moderate pressure per inch of bearing surface.

Wherever possible, bearings should be supplied with removable linings, preferably of antifriction metal. In all cases, whether thus lined or otherwise, they should be scraped smooth and true, properly adjusted and arranged for the ready distribution of lubricant—all of this tending toward a lower coefficient of friction for these bearing surfaces.

Complete provision should be made for a plentiful supply of lubricant to all bearing surfaces, furnished preferably by an automatic system which will be effective and efficient at all speeds.

Utmost simplicity should be sought throughout, reducing the number of parts, the number of joints (each an element of weakness), and the number of bearings, with their attendant friction and their possible loss of economical adjustment.

The design should afford a ready accessibility at every point, inviting frequent and careful attention to the maintaining of a correct adjustment of all parts for most efficient operation.

Friction has been aptly defined as "That portion of the power consumed by a machine in wearing itself out." True economy is a question, not of momentary results, but of results covering months and years of continuous service under all conditions; and a compressor in which the percentage of "wearing out power" is least, promises not only the highest, but also the longest, record of sustained economy and satisfactory service.

Governing

WHILE the regulating devices or governors used on steam-driven air compressors vary in detail among the different builders, all may be divided, so far as the principle of operation is concerned, into 2 classes.

The first class is that applied to compressors with plain or adjustable cutoff valves of flat or piston type. It operates by throttling the steam supply as load diminishes. Devices in this class consist fundamentally of a valve in the steam pipe, which is opened or closed by the action of a piston in a cylinder, this piston being actuated by air pressure from the receiver.

Movement of this piston is opposed by weights on a lever or by a spring; and the spring tension or the weights may be adjusted so that the governor valve is full open at any desired normal air pressure. But when pressure exceeds this limit, the tension or weight is overcome, and the valve in the steam supply is closed in a degree corresponding with the amount of excess pressure. This slows down the machine and reduces the volume of air discharged until such time as the normal pressure is reached, when the weights or spring tension again open the governor valve, and full speed is restored. Evidently this partial throttling of the steam supply will result in some wire-drawing of the steam, which is about offset by the resulting superheating of the steam.

In the second class are governors applied to machines with Corliss steam valves. The mechanism consists of a pressure cylinder and piston with opposing weights or springs, as described in the preceding paragraph; but in this case the movement of the governor, instead of throttling the steam, changes the cutoff of the steam valves, reducing speed under partial load, and restoring it as load increases. The resistance per stroke being the same throughout, a very slight change of cut-off, hardly affecting the economy, produces all the speed change necessary.

Both of these classes of governors include also a speed-limiting device, the more common form being the familiar flyball arrangement, which throttles the steam supply or greatly shortens the cutoff when speed exceeds a certain limit, as it might in case an airpipe should break or other accident occur.

USE OF CONDENSER TRAPS

By James M. Taggart

ONE reason that leads to the use of high-pressure steam in heating and drying apparatus is the fact that a positive pressure is often needed to remove the condensation. That is in order to render the apparatus effective the condensation must be removed as fast as it collects. High pressure is, however, not necessary to accomplish this. It can be accomplished more easily by means of the condenser trap in which a vacuum is formed by a cold water spray. In practice vacuums ranging from 5 to 12 lb. per sq. in. are obtained. In some cases vacuum pumps have been used for this purpose, but, for handling hot water, traps are more efficient, effective and reliable.

With certain materials it is desirable that the temperature should not be raised to any extent, in which case they may be dried in a vacuum suited to allow vaporization at a temperature well below that which will injure the material. The subject of drying in a vacuum is one which should be investigated chemically, as well as from an engineering standpoint, before being tried out in practice. With vacuum drying the use of high-pressure steam should never be required.

The success of a combined power, heating and drying system depends entirely on its intelligent design and the proper selecting of apparatus. Not only the general plan but all details must be carefully considered and determined by one of experience who is familiar with the technique. A little expenditure for brains has been found to pay better than anything else in all lines of business.

RECENT IMPROVEMENT IN CORLISS VALVE GEARS

THE ordinary type of admission valve gear on Corliss engines depends upon a spring to overcome the effect of inertia upon the disengaging links. The faster the engine runs the heavier this spring and its pressure must be to cope with inertia and insure uniform latching. Hence on a high speed engine severe wear is incurred upon the rollers or guides holding the latch to its path and at the same time a heavy reaction is transmitted to the governor. The springs, rollers and various devices therefore must be given constant care and adjustment or they become noisy.

A new type of admission valve mechanism, styled the "inertia gear" by its designer, Ernest A. Moore, chief engineer of the Bates Machine Co., and now regularly used on all Bates-Corliss engines, is offered to overcome these inherent faults of existing types of admission valve gears. With this inertia gear, the disengaging parts, instead of being forced into and held in their path by springs, rollers or other devices, travel in the desired path by natural forces involved in the movement.

Referring to Fig. 1, the dash pot arm is in the form of a bell crank, one arm carrying the dash pot rod and the other the catch block. The dash pot arm is keyed to the valve stem and a sleeve on its inner side fits into a bored recess in the steam bonnet, thereby gaining great bearing surface.

The steam arm has a liberal bearing surface on the bonnet and is driven by the valve rod in the usual way. A substantial boss on the steam arm carries the latch shaft on the inner end of which is firmly mounted the knock-off bar, these 2 parts forming practically one solid piece of steel. The knock-off ring is controlled by the governor and carries the knock-off cam and safety cam. The latter comes into operation only in the event of some mishap to the governor, when the cam is thrown into such a position that the valve cannot be opened.

Operating movements are as follows: In opening the valve, the valve rod moves to the left, the latch shaft engages with the block in the position shown in sketch, and continues in this path until the knock-off bar comes into contact with the knock-off cam and is forced outward, raising the latch until the block is released. The dash pot then comes into action and returns the arm to which the block is attached to the original position. The follower pin is firmly fixed to the steam arm and acts

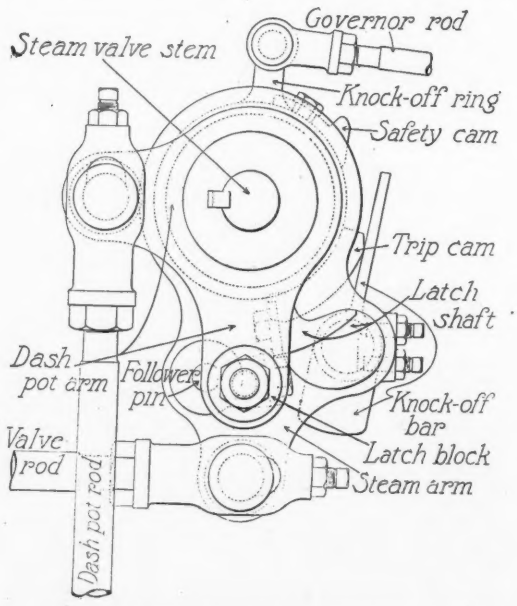


FIG. 1. ARRANGEMENT OF NEW INERTIA GEAR FOR CORLISS VALVES

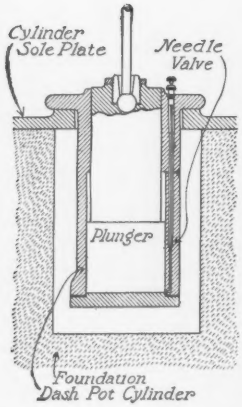


FIG. 2. THE DASH POT

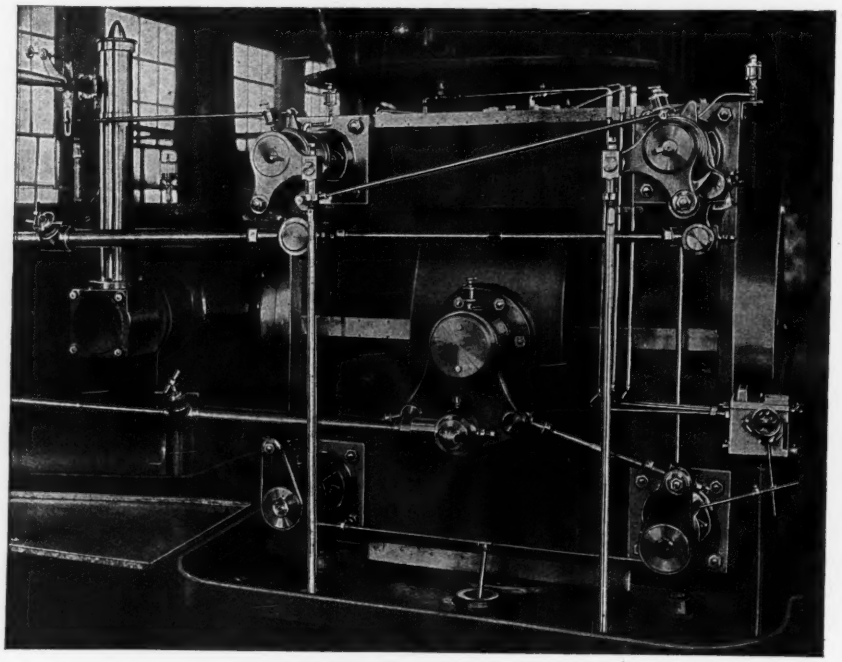


FIG. 4. THE COMPLETE INERTIA GEAR ON THE CYLINDER

only in the event of the dashpot failing to close the valve.

Construction and balancing of the latch shaft and its knock-off bar attachment are such that the inertia due to the reciprocating motion and the gravity of the parts assures an automatic latching action at the end of the return stroke between shaft and block without the use of any spring, or mechanical device of any kind, and in turn assists the unlatching at the point of cutoff, thereby reducing the reaction on the governor.

Depth of latching and the amount of clearance of the catch blocks may be set to a nicety and with the greatest ease while the engine is running full speed; which is accomplished by 2 adjusting screws.

This valve gear has been thoroughly tested and found to work positively and quietly up to the limit speed of vacuum dash pots, considerably over 250 r. p. m.

The dashpot now used on Bates Corliss Engines is also of special design and is claimed to be remarkable

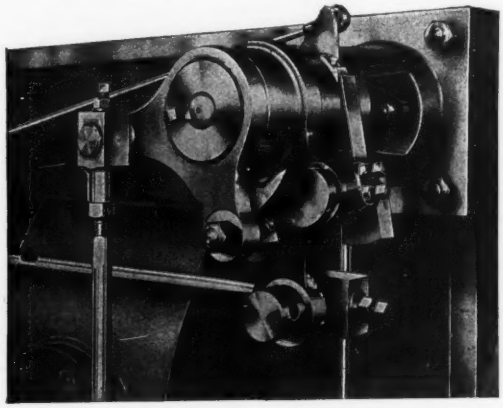


FIG. 3. BATES INERTIA GEAR AS ASSEMBLED

for quick action, noiseless operation and durability. It is set beneath the soleplate, is made without packing or leather of any kind, and the method of cushioning enables it to act over the wided range of lifts without requiring adjustment.

Referring to Fig. 2, the dashpot cylinder and plunger are of 2 diameters with ground fit on each. With the plunger at lowest position as shown, there remains an annular internal chamber which is full of air. An air passage way is provided from the chamber to a point underneath the plunger, and the area of this passage may be varied by the needle valve to regulate the amount of air transferred to the lower chamber.

In operation, the air is displaced from the annular chamber to the vacuum chamber below the plunger exactly in proportion to the lift of the pot, the air so transferred forming the cushion. Thus the cushioning effect is always proportionate to its work, and the air is driven back and forth within the pot noiselessly instead of escaping to the atmosphere with the disagreeable hissing commonly heard.

These improvements in gear and pot afford noiseless and positive operation of the valves at slow speeds, but their importance is greater as the speed increases. It is claimed by the manufacturers that this is the quietest Corliss gear yet produced, all noise having been eliminated except that of the actual contact of the latch blocks. The improvements have been attained with practical, simple construction that is particularly compact and accessible and without anything of a trappy nature.

Other changes in the design of the Bates Engine have recently been made with a view to keeping as nearly as possible in line all working strains in the valve drive, and both steam and exhaust drives are fitted with telescopic detaching device to enable the valve gear to be worked by hand. The engine frame has also been strengthened by making the casting heavier and using the full Tangye type of construction.

A TRIPLE RIVETED RULE AND ITS RUPTURE

By C. H. Bromley

IT was a triple-riveted, butt-jointed, thoroughly caulked and well stayed rule that no one shall enter the P—— Co.'s plant without good and sufficient reason. Hence an athletic uniformed watchman stood at the main gate. This Apollo of the gateway is of course human and heir to human frailties despite his brass buttons and imposingly decorated cap. So one day a stranger, well groomed, 'tis true, but no less objectionable, had the colossal audacity to transport himself within the walls of this sacred department. How he gained admittance is a problem I'll not try to unravel. It's too complex. Some say he chloroformed the watchman, while others contend he came concealed in a bale of waste. However correct these theories may be, the fact remains he got in somehow—endeavored to rupture this triple riveted rule whose tested tensile strength is 80,000 lb. In fact, he did rupture it, and he knew it—before he got out.

As this great plant covers nearly 2 large city blocks, the cellars are—well the're something awful! The're so crooked, so full of dark passages and low hanging pipes that the chief himself usually requires a guide when going through. There are innumerable doors of many varieties, and, of course, they are all locked. Some are lattice work steel doors located near an unseen window through which daylight floods the cellar. You can see all this but you cannot reach the daylight—the doors are locked. So it was with our hero, the intruder.

Now a word about his supreme excellency the chief. He was a German, short, of stocky build and a vandyke beard so black you could see it in an ink-dark room. And eyes! well they could pierce anything clear through. They say when he was foreman in a boiler shop long ago the punching machine broke down one day and while the machinists were busy making repairs he looked holes through the plates just to save time.

After a couple of hours wandering in the cellars, vainly trying to find his way back, his head covered with huge bumps from sudden contact with pipes, hatless, and his clothes covered with dust and grease of 57 varieties, our hero finally emerged into the polished marble floored engine room only to be confronted by the firy-eyed chief, whose title he was ignorant of and of whom he demanded: "How the hell will I get out of here?"

The chief threw on him that X-ray gaze and our hero withered as would a rose before the furnace door, as he in turn thundered:

"Vel! how the hell dit you get in here?"

"It is not enough to have energy. One should learn to expend it wisely. Excellent work is based on understanding and guided by real efforts. Poor work is for a day, while good work belongs to eternity."

Fire losses and the cost of fire prevention in the United States amount annually to $450,000,000, or more than the total American production of gold, silver, copper and petroleum in a year.

Electrical Machinery

For Generating, Transmitting and Using Current

TRANSFORMER TESTING

TAKING CARE OF LEAKS OUTSIDE THE POWER PLANT

By V. E. Johnson

IT is a peculiar fact that many engineers and central station men—while carefully analyzing flue gases, filtering and refiltering oil, and doing everything possible to save coal and so reduce the cost of production of power, completely overlook equally important features in the allied field of distribution. It is true that in most of the larger stations, the chief is not concerned with anything outside of the engine room and that his duty ends when he has reduced the price per kilowatt to the lowest possible amount.

It is equally true, however, that there are hundreds of smaller plants where the chief is recognized as the man responsible for both production and distribution and it is to this class of men the following discussion ought particularly to appeal.

Nobody doubts that it pays to test integrating wattmeters. A few per cent lost here and there soon make a noticeable reduction in the profits, and the manager is not slow to discover the reason. But year after year the old transformers are left in service—year after year as the iron ages the losses increase—not losses during a few hours each day, but continuing 24 hours a day, month after month and year in and year out, no one ever thinks of testing them.

They are still supplying a current to the lights or motors attached, so naturally they must be in good condition. Occasionally a man is killed while turning on a light and a damage case following calls attention to the fact that the insulation sometimes weakens; but that is as far as it usually gets.

I know of a plant in a city of 50,000 inhabitants—a 1000 k.v.a. station—which has never had a transformer tested for anything but short circuits and open circuits in the 30 odd years of its existence. And yet they wonder why the output at the switchboard so far exceeds the intake at the cashiers windows. They are just beginning to wake up and at the present time though not testing any transformers, are arranging them into groups in such a manner as to eliminate the wasteful "one house secondary" arrangement.

Transformers are usually bought under specifications with a guaranteed iron loss, regulation, exciting current and disruptive strength of insulation. They are tested thoroughly at the factory and if the maker is reliable there is very little question but that they leave the factory complying with the contract specifications. Even at that a test for iron loss and regulation should be performed.

The following table may serve as a guide in specifying.

Capacity	Iron loss	Exciting current
1000 watts	30 watts	0.055 amps.
1500	40	0.060
2000	50	0.080
2500	60	
4000	80	
6500	100	0.100
7500	150	0.200

Iron losses for 100 cycles or more should not be grater than above, though for 60 cycles 10 per cent greater loss may be allowed in order not to unduly increase first cost. Voltage drop from no load to full load should not exceed 3 per cent.

After 10 hours run at full load the temperature should not be more than 70 deg. F. above the surrounding air.

Insulating strength should be for ordinary transformers 7 to 10 times the primary voltage; and the insulation resistance not less than 10 megohms. As age affects insulating qualities, the specifications should contain a clause stating that above values are to hold true after the transformer has been in service long enough to make these qualities nearly a constant.

Exciting current not to be greater than shown in the above table for frequencies 100 or above. For other frequencies the current increases as the frequency decreases. It also, of course, varies inversely as the pressure, so that the reading obtained in testing a 1000-volt transformer with 100-volt current would have to be 10 times that shown in the above table.

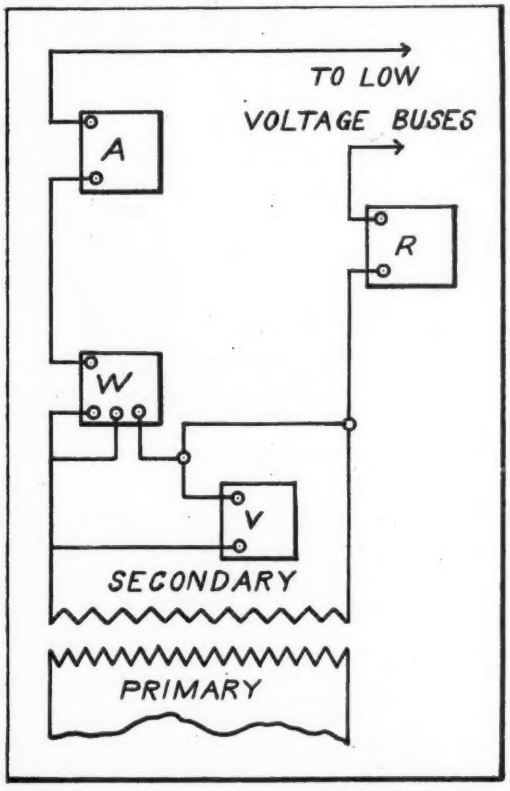
A greater loss or exciting current than these above stated increases the cost of distribution and eats into profits at an alarming rate; poorer regulation means complaints on account of poor service and dim lights; poorer insulation is a constant menace to the lives of the consumers and should not be tolerated.

But, even with a high grade transformer which when new is satisfactorily efficient and safe, time introduces elements which must be considered. The iron is constantly aging; increasing by the hysteresis losses; overheating and lightning may strain the insulation though not actually destroying it and various conditions will interact until a point is reached where economy and safety demand the removal of the instrument (if a transformer is an "instrument") and its replacement by a new one. It is impossible to determine when this critical point has been reached, without resorting to periodical tests, once a year if possible, every other year at any rate. The procedure is simple, and even if it were not the necessity is

surely great enough to warrant its conscientious carrying out.

For iron losses and exciting current, and regulation tests, all that is necessary is an ammeter (for alternating current, of course), and an indicating wattmeter. These can be obtained from almost any reliable maker for less than $100. If an indicating wattmeter cannot possibly be obtained, the ordinary integrating instrument will do, in which case a stop watch would be used in addition, and the readings reduced to watts per hour.

For insulation testing a high-potential transformer is necessary, also a spark gage. These are rather expensive but are well warranted outlays, for one lost damage case will pay for the device. These cases are



CONNECTIONS FOR DETERMINING CORE LOSS AND EXCITING CURRENT

always accompanied by more or less unfavorable comment which in itself is a loss not calculable in dollars and cents. Full directions for use always accompany a testing set for insulation tests so no further instructions in regard to these will be given.

The diagram shows connections for iron loss and exciting current test. When the variable resistance R is adjusted until the voltmeter V reads the standard secondary voltage, the ammeter A will indicate exciting current, and the wattmeter W the iron losses, consisting of hysteresis and Foucault current losses combined. Ordinarily it is not necessary to separate these losses, but to the student engineer who wants to know for the sake of knowing, the following solution may appeal. This method was used at the University of Wisconsin during a long series of transformer tests conducted there some time ago.

Temperature does not affect hysteresis losses, within ordinary limits, as hysteresis is a quality inherent in the iron. Foucault currents are, however, affected by temperature, as any changes in temperature change the resistance of the iron through which they flow. Hence if we test for iron losses with a cold transformer, and again with a hot transformer we will get 2 sets of readings, each composed of a constant and a variable.

Let H=hysteresis loss; F=Foucault current loss; R=resistance of iron in path of Foucault currents; a=temperature coefficient of iron [i. e. R cold$\times$(1+at) =R hot]; I=total core loss; E=e. m. f. which sets up Foucault currents; t=difference of temperature at which the 2 tests are carried out; C=current; and K =a constant. The exponent letter ^{h} or ^{c} indicates whether instrument was hot or cold. Then:

Total core loss cold $I^c=H+F^c$ (1)

Total core loss hot $I^h=H+F^h$ (2)

The Foucault current loss equals:

$$F=C\,E=\frac{E^2}{R}$$

But E is a constant as it depends on the frequency and magnetic density in the core only. Hence:

$$F=\frac{K}{R} \quad (3)$$

$$\text{and } F^c=\frac{K}{R^c} \quad (4)$$

$$F^h=\frac{K}{R^h} \quad (5)$$

But from the definition of the temperature coefficient we have:

$$R^h=R^c\,(1+at) \quad (6)$$

$$\text{Substituting in (5) } F^h=\frac{K}{R^c(1+at)} \quad (7)$$

(1)—(2) $I^c-I^h=F^c-F^h$

From (4) and (7)—substituting we get:

$$I^c-I^h=\frac{K}{R^c}-\frac{K}{R^c(1+at)}=\frac{K}{R^c}\left\{\frac{at}{1+at}\right\} \quad (8)$$

$$\text{or } \frac{K}{R^c}=(I^c-I^h)\div\left\{\frac{at}{1+at}\right\}$$

But from (4) $\frac{K}{R^c}=F^c$. Therefore,

$$F^c=(I^c-I^h)\div\left\{\frac{at}{1+at}\right\} \text{ or } (I^c-I^h)\left\{\frac{1+at}{at}\right\}$$

ENGINE-DRIVEN DIRECT-CURRENT INTERPOLE GENERATORS

INCREASING use of electric power demands overload capacities in direct-current generators, together with sparkless commutation and the highest degree of mechanical excellence. The new standard line of Westinghouse Type Q interpole direct-current generators is designed to fulfill these requirements and furnishes an excellent engine-driven generator for direct-current 2-wire or 3-wire service.

Prominent characteristics of these generators are interpole construction, thorough ventilation and ruggedness with relatively light weight. The interpole construction provides perfect commutation, with a definite brush position covering all ranges of load. Heavy overloads may be imposed without sparking or flashing, and wear on commutators and brushes is reduced

to a minimum. Ventilation of all current-carrying parts and of the armature cores is such that there can be no hot spots at points dangerous to the insulation.

Frames are of cast steel, a material of high magnetic permeability, which furnishes ample strength with economy of both weight and space, contributing to good ventilation, low freight charges and easy handling. The rotors or armatures are designed for direct mounting on the shaft of the prime mover, which may be of any type of suitable speed. The stators or fields are arranged for mounting on masonry foundations or directly on the bedplate of the prime mover.

Ventilation has received particular attention in the design of these machines. The design of all the windings is such as to give shallow coils with the result that the heat in any part has but a very short distance to travel to the surface from which it is radiated. This, with a very complete and thorough system of air circulation, insures an entire absence of hot spots and a uniformity of temperature never before obtained in similar machines. These features enable these generators to stand heavy overloads without injury.

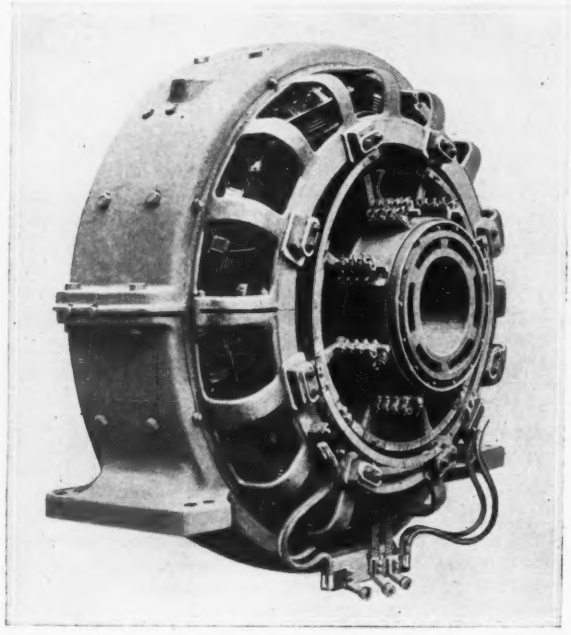


FIG. 1. WESTINGHOUSE INTERPOLE GENERATOR

Type Q generators are standardized for desirable and usual ratings from 25 to 1000 kw., with speeds conforming to the best engine practice. Up to 100 kw. in capacity the standard voltages are 125 or 250. From 100 to 300 kw. these machines are wound for 125, 250 or 600 volts, and from 300 to 1000 kw. they are wound for 250 and 600 volts. Machines of 250-volt rating are regularly equipped for 3-wire operation.

Most electrical troubles in a direct-current generator arise from faulty commutation, especially during overloads. They begin with sparking, which burns away the copper and brush, causing high mica, roughness of surface, flashing, break-downs in insulation and deterioration of brushes, brush holders and commutators.

In a non-interpole generator, sparking is primarily due to a local magnetic field surrounding a coil which is being commutated. This field sets up an electromotive force in the commutated coil, in such a way as to oppose the reversal of the current in the coil, and thus tends to cause sparking as the coil or commutator bar leaves the brush. This action increases with the current or load and is especially destructive on heavy overloads. Sparkless commutation may be obtained if the brushes can be so located that the armature coils short-circuited by them are brought into a magnetic field of exactly the right direction and strength to neutralize the effect of the local field at the moment of commutation.

Such a field is found to exist near the tips of the pole pieces and it has been customary to advance the

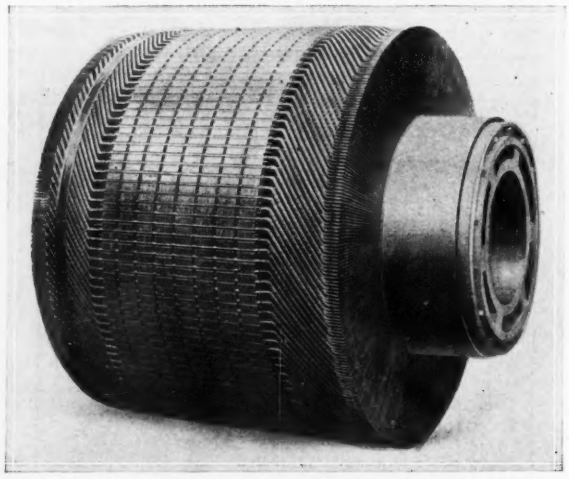


FIG. 2. ARMATURE OF WESTINGHOUSE TYPE Q GENERATOR

generator brushes sufficiently to bring the armature coils within it during commutation; but this field varies in strength under various conditions of load. Instead of becoming stronger as desired with increase of load, it actually becomes weaker. The proper conditions for commutation are obtained by the use of small poles in type Q generators, interspaced between the main poles.

The interpoles have their windings in series with the armature and set up a magnetic field which annuls the effect of the field formed by armature magnetization and generates in the commutated coil an electromotive force which assists the reversal of the current. Since the interpole coils are in series with the armature, the interpole field strength varies in proportion to the load and it thus has the proper corrective effect at all loads.

Since the electromotive force due to the interpole, which assists reversal, has a definite position under the interpole, the coil being reversed must be located accurately with respect to this reversing electromotive force. Therefore, the correct position of the brushes must be determined accurately before the generator is put in service. When this point has been properly located, shifting the brush position is not only unnecessary but detrimental.

IN THE ARTICLE describing the plant of the Kelley-Racine Rubber Co. in the September issue, mention was omitted of the fact that erection of all piping was handled by Horace L. Winslow Co. of Chicago, F. H. Krueger being in charge of the work.

"AS A MAN thinks so he acts and as he acts so he succeeds."

HEAT TRANSMISSION IN BOILERS*

PLUGGED PIPES INSIDE 4-IN. BOILER TUBES RESULT IN 10 PER CENT GAIN IN COAL ECONOMY

By V. L. Rupp

HAVING been convinced from observation and investigation that a 4-in. tube is too large to use in a horizontal tubular boiler 15 ft. in length, and that a large part of the gases passes through the upper rows of tubes, I decided to make some experiments to ascertain what improvements could be effected.

The boiler on which the experiments were made was 15 ft. in length, 5 ft. in diameter, and had 44 4-in. tubes and was rated at 80 hp. The grate area was 25 sq. ft.

At A, Fig. 1, a hole was drilled through the boiler front to take temperature of the gases after they had passed through the tubes, and another hole was drilled at

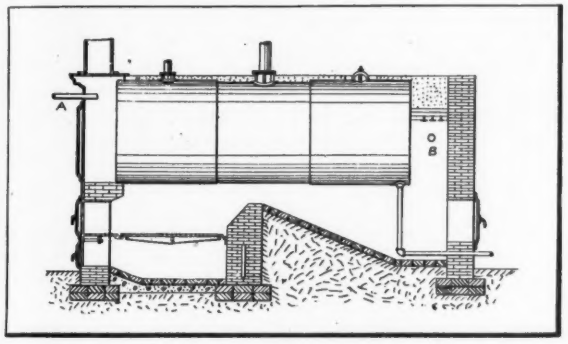


FIG. 1. POINTS OF TEMPERATURE OBSERVATION

B, through the side wall of the setting at the back of the boiler to take temperature before the gases entered the tubes.

With the boiler in regular service a series of temperature readings was taken. As plotted in Fig. 2, the average temperature for the front of the boiler being 559 deg. and for the back 1388 deg., shows a drop in temperature through the tubes of 829 deg.

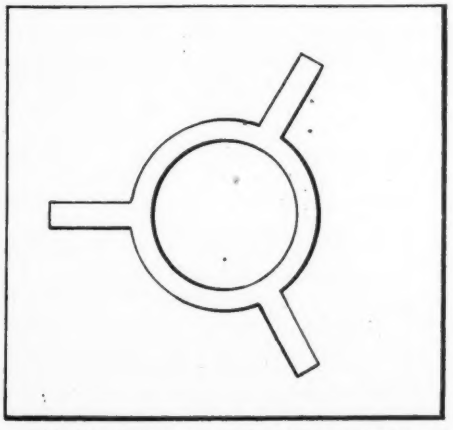


FIG. 3. CASTING USED AT ENDS AND MIDDLE OF PIPES

Since the volume of a gas at constant pressure varies directly as its absolute temperature it is well to note the difference in volume of the gases at points A and B. The ratio is nearly 2 to 1. Now, if the volume of the gases at B is twice as great as at A, the gases will travel at twice the velocity at the back end of the tubes that they do at the front end. This being the case the tubes are much more efficient in the conduction of heat at the back end than they are at the front end, if the theory that heat transfer is influenced by the gas velocity is valid.

I decided to try to increase the velocity of the gases through the entire tube length and at the same time bring the gases into more intimate contact with the heating surface. After some calculations regarding the amount of gases passed by the tubes and finding out that I could cut down the tube area and still pass sufficient gas to burn the required amount of coal. I had a small casting made as shown in Fig. 3.

This was made so as to be a neat fit in the tubes and allow a 1¼-in. pipe to pass through the center. A quantity of old 1¼-in. pipe which had been taken from the

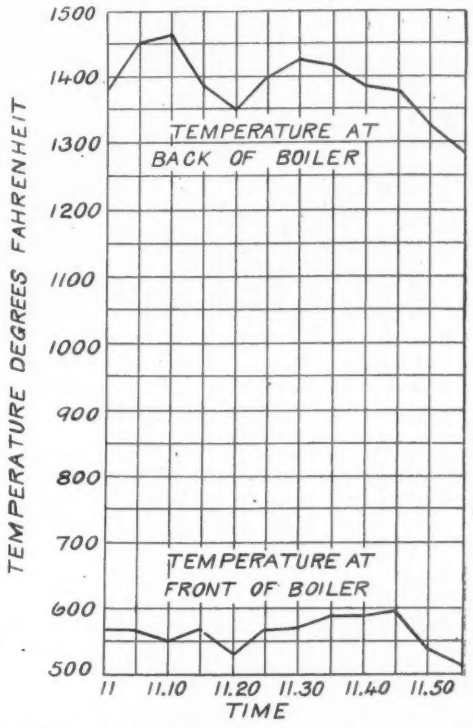


FIG. 2. TEMPERATURE VARIATIONS AT FRONT AND BACK OF BOILER WITHOUT INNER TUBES. NOTE REDUCTION IN PASSING THROUGH TUBES

heating system was lying in the stock room, and this I had cut into 15½-ft. lengths. One casting was put on the pipe 12-in. from each end and one in the middle, and fastened in place with small setscrews. The pipes were then sealed at each end with fireclay and put into the tubes. The boiler was not cut out of regular service after the pipes had been put into the tubes and everything was done to have the same conditions as when the previous temperature readings, shown in Fig. 2, were taken.

*Abstract of paper read at annual meeting of the Institute of Operating Engineers, New York, September 1, 1911.

A series of temperature readings was taken with the pipes in the tubes, as plotted in Fig. 4, curves A. The average temperature at the back of the boiler was 1531 deg., and at the front, 486 deg., showing a drop through the tubes of 1045 deg. It was found from a great number of readings that if the average temperature at the back of the boiler was over 1500 deg., the temperature at the front without the pipes in the tubes was 625 deg. or over.

The boiler was forced with a blower to see how high a temperature could be obtained at the front end, and curves B, Fig. 4, give the results. The average temperature at the front of the boiler was 552 deg. and at the back 1686 deg. giving a drop through the tubes of 1134 deg. One thing that should be noted in particular in this test is that after the temperature at the front

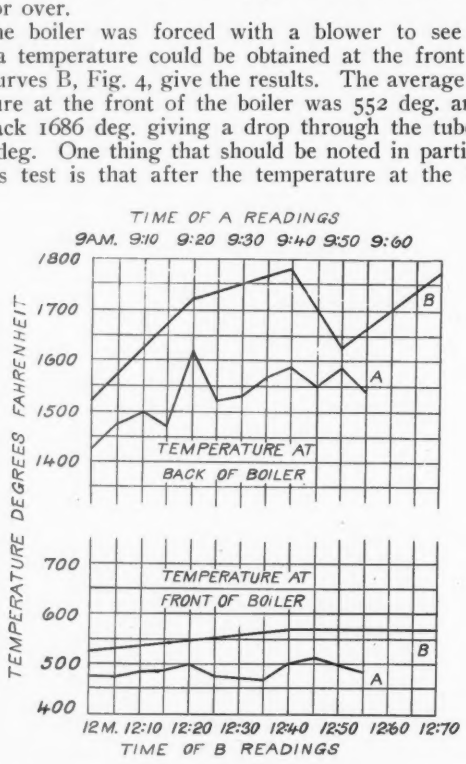


FIG. 4. TEMPERATURES WITH INNER PIPES IN PLACE. CURVES A AT NORMAL OPERATION. CURVES B WHEN FORCING THE BOILER

reached 565 deg. it seemed to hang at that point, although one of the readings of the pyrometer at the back gave a temperature of 1785 deg. It was not deemed advisable to force the boiler longer than 35 minutes as it began to prime.

I was not fully convinced that the improvement observed was due entirely to the 1¼-in. pipes in the tubes as it seemed possible that the restricted tube area caused a more equal flow of the gases through the tubes as a whole. Therefore, I removed the pipes and inserted a small metal ring in the end of each tube so as to give the same area for the flow of the gases as did the pipes.

While this showed some improvement over the conditions obtained with the boiler unchanged in any manner, the results were not to be compared with the improvement shown by the use of the pipes in the tubes. The improvement was great enough, however, to bear out the theory that the larger part of the gases passed through the upper rows of tubes.

Boiler tests were run with and without the pipes in the tubes. The test with the pipes in the tubes showed a 10 per cent greater evaporation per pound of coal.

The pipes have been in the boiler for about 2 years and are in good condition with the exception of about a foot at the back end. The fuel used was buckwheat and no trouble was experienced in keeping the tubes clean.

OPERATION COSTS

COSTS of operation are a vital feature of the engineer's responsibility and daily work at the present time, and the summary of figures given herewith is of interest to every engineer for comparison with the performance of his own plant. These figures have been gathered from a number of sources. Part of them have been taken from Steam Power Plant Engineering, by Gebhardt, part of them from papers before the engineering societies and part from articles given in The Isolated Plant. The plants comprise all sorts of installations and of various sizes to represent fairly correct practice.

In the first, which is a small plant for an apartment house, there are 2 generators of 45 kw. having an average load 48 per cent of the capacity, using pea coal and maintaining boiler pressure of 90 lb. with horizontal tubular boilers. The coal used per kilowatt hour is 15.5 lb.; per horsepower hour 12.1 lb. The cost per kilowatt hour for current, charging everything against the switchboard, is 6.4 cents.

In the second plant are 2 generators of 69 kw. capacity, having an average load of 20 per cent, using buckwheat coal and generating steam at 100 lb. pressure. This plant uses 25.1 lb. of coal per kilowatt hour or 19.5 lb. per horsepower hour, and the cost, everything charged against the switchboard, is 12 cents per kilowatt hour.

The third plant, having 3 generators, 175 kw. capacity, uses buckwheat coal, making steam at 125 lb. pressure and with an average load of 60 per cent capacity; uses 18.4 lb. of coal per kilowatt hour or 14.3 per horsepower hour. The cost is 5.5 cents per kilowatt hour.

In a club having 3 generators with 130 kw. capacity, the buckwheat coal is used, generating steam at 90 lb. pressure and carrying 40 per cent average load. The coal used per kilowatt hour is 11.1 lb., per horsepower hour 8.62 lb. The cost per kilowatt hour is 5.7 cents.

In a large office building having vertical engines direct-connected to water tube boilers, 4 generating units 150 kw. capacity each, carrying steam at 150 lb. pressure, charging only the power current against the switchboard, takes 6.57 lb. of coal per kilowatt hour or 5.5 lb. per horsepower hour. Charging everything against the switchboard the coal used is 19.34 lb. per kilowatt hour or 15 lb. per horsepower hour, and the total cost is 5 cents per kilowatt hour.

In a mill plant having cross compound condensing engine of 1500 horsepower, and 4 500-hp. boilers, running on a 24-hour schedule, the results of a 14-day test showed actual horsepower of 2400, minimum of 1870 and an average of 2160. Coal per indicated horsepower was 1.7 lb. and the total operating cost 0.396 cents per indicated horsepower hour. It should be noted here that this charge is for power only, and per indicated horsepower, whereas figures previously given have been per horsepower delivered at the switchboard.

A plant located in Chicago, operating a small hotel, has 2 125-hp. tubular boilers, 1 35-kw. generating unit and 1 62½-kw. The coal used per horsepower hour is 26.3 lb. and the operating expense per kilowatt hour is 8.5 cents.

"SKILL IN LITTLE things requires training in little things, self-training in little things about the old lines and in little things about new lines."

EVAPORATOR SYSTEM OF REFRIGERATION

By Heywood Cochran

IN plants where exhaust steam is not available and it is desired to make distilled water ice, the compression system has been that commonly employed, but during the past year the Carbondale Machine Co. has developed what is called an evaporative system which gives excellent results in economy. A plant employing this system has been installed for the Southern Ice & Fuel Co., which, upon test, made 33.3 tons of distilled water can ice daily with 3.55 tons of Alabama coal, and in addition cooled an ice storage room 42 by 14 by 12 ft., taking about 2 tons of refrigeration.

The ice-making machine is a standard Carbondale exhaust steam absorption machine, the generator of which utilizes the exhaust steam of all the auxiliaries, viz., pumps, agitator engine, etc., at a pressure of about 10 lb. per square inch. This generator requires about 55 lb. of steam per hour for each ton of ice made daily, with cooling water at 70 deg. Thus, for 24 hr., the generator requires 39,600 lb. or 19.8 tons of steam, or, in other words, furnishes 19.8 tons of distilled water. To make 30 tons of ice it is necessary to have 33 tons of distilled water, which allows for skimming losses, loss at can dump, etc. As the generator furnishes 19.8 tons, the difference, or 13.2 tons of water, must be made up by some other means.

To obtain this additional distilled water, the evaporator system was installed in connection with this plant. With this system, steam is carried in the boiler at 110 lb. per square inch, and passes at this pressure to the coils of the evaporator, constructed very much like the generator of the ice machine. Water surrounds these coils, and the live steam at 110 lb. pressure (344 deg. F.) heats and evaporates this water into steam under 70 lb. pressure (316 deg. F.). The evaporator is so proportioned that 13.2 tons of live steam is condensed in the coils daily.

This condensed live steam is trapped and delivered to the reboiler, while the steam evaporated at 70 lb. pressure, together with a small quantity of live steam, is used to run the auxiliary pumps, engine, etc., which, in turn, exhaust into the ammonia generator under 10 lb. per square inch. As mentioned, the generator condensation is 19.8 tons daily. This is trapped to the reboiler, which, added to the 13.2 tons already delivered to the reboiler by the evaporator, makes the necessary 33 tons of distilled water for the production of 30 tons of ice, allowing, as previously mentioned, about 10 per cent for unavoidable losses during the operation.

As stated above, the evaporator condenses about 13.2 tons of live steam. The quantity of water evaporated into steam at 70 lb. runs about 10 per cent less, so that the evaporator furnishes the auxiliaries with 11.9 tons of 70 lb. steam. As the generator requires 19.8 tons of exhaust steam daily, and the auxiliaries have a loss of about 5 per cent due to cylinder condensation, the total amount of steam supplied the auxiliaries and generator is about 20.8 tons daily. As the evaporator only furnished 11.9 tons, the balance is by-passed or supplied through a reducing pressure valve from the boiler, and amounts to 20.8—11.9 or 8.9 tons daily.

The amount of live steam required from the boiler to make the full amount of distilled water and run the plant is

Steam required by evaporator.....	13.2 tons
Additional live steam to run the auxiliaries.	8.9 tons
Live steam to reboil distilled water.....	.2 tons
	22.3 tons

Thus it is seen that 22.3 tons of live steam make 33 tons of distilled water. As the evaporator was rather liberal in surface, no difficulty was experienced in actually making sufficient distilled water for 33.3 tons of ice.

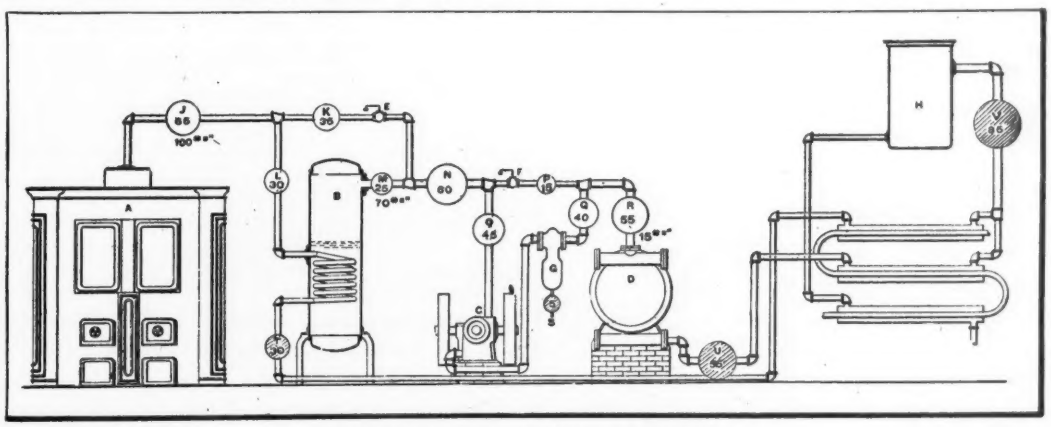
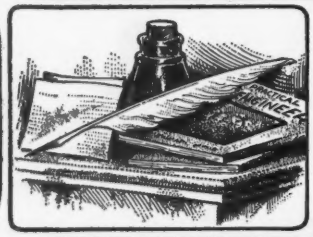


DIAGRAM OF THE EVAPORATION SYSTEM

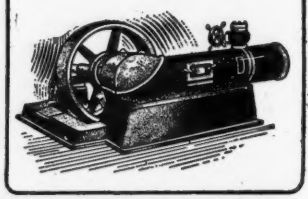
On Oct. 31 a demonstration of safety apparatus for mines will be held at Forbes Field, Pittsburg, Pa., under the auspices of the American Red Cross, the Pittsburg Coal Association and the United Mine Workers of America. Teams of miners will exhibit there skill in first aid work and special devices showing the effect of explosions will be demonstrated, also the method of mine rescue by the use of oxygen helmets. It is expected that President Taft, Governor Tener, of Pennsylvania, and Secretary Fisher of the Department of the Interior will be present and take part in the proceedings.

Benjamin T. Delafield, who formerly represented Lunkenheimer Company for a number of years in the St. Louis and Kansas City territory has become connected with the Best Manufacturing Company of Pittsburg, Pa., to handle their line of valves, fittings, flanges, pipe bends, fabricated pipe and other power plant material in the same territory. He will make his headquarters in Kansas City.



Letters from Engineers

Bright Ideas direct from the plant. Send us yours. Cash paid for those accepted. Sketches desirable; we make the drawings



ENGINE LEAKS

SOME of the hidden leaks in our power plants are the ones that gradually steal away the cash from the cash drawer and send it to the coal man. We have a few examples before us which belong to our steam engines and pumps. Many times the pistons of our engines run along for months with broken rings, wasting much steam and fuel, and again they will run along with a loose-fitting piston and rings, which is almost as bad, when the engine has been run a long time and the cylinder has become much worn. Not only do we need to renew the rings, but the piston as well in order to have a good tight cylinder. The piston must fit closely to the side of the walls of the cylinder. The mere fact of putting in new rings does not always put our engine cylinder in the best condition, as when the piston head has become worn down it will not support the rings properly.

Frequently we can help the rings in the engine cylinder, which have been run a long time, by peening them out some. Figure 1 shows a ring in the peening

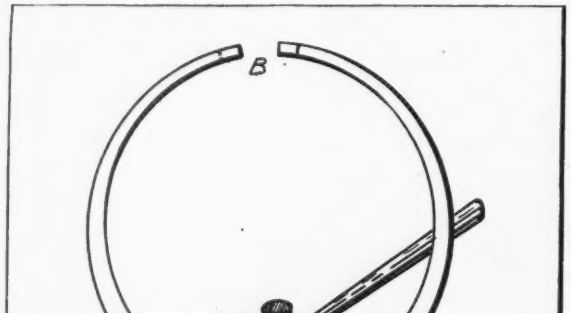


FIG. 1. PEENING A PISTON RING

process. Simply have the outside portion of the ring on a smooth surface and peen the inside with a hammer as shown. This should be done with some precaution. Do not peen all in one place, but work around on the ring. When you commence to peen you will notice the ends at B will begin to open up and in this way you will throw more tension on the ring, and it will work closer against the walls of the cylinder, consequently will make a tighter cylinder.

One of the greatest sources of loss by rings in our cylinders is the wearing of the rings in the grooves. A ring must fit close in its grooves, just enough play to allow it to slip is all that should be allowed. This side groove play is shown at M in Fig. 2, and is a source of a considerable leak. The lap joint on the rings when in this condition causes a leak as well. The steam will blow through just as illustrated by the line marked "steam." This steam passes down beneath the point of the ring and comes up through the joint.

Another source of leak is by the point of the ring B, Fig. 2, becoming broken off. This frequently happens

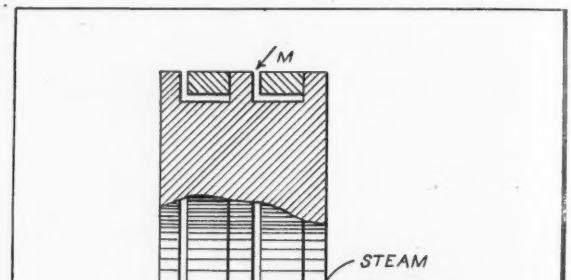


FIG. 2. LEAKING POINTS OF A PISTON

and engines will run a long while without it being detected. When our ring grooves become much worn they should be sent to a shop and redressed before fitting in a set of new rings as the grooves become untrue and a new set of rings will not fit accurately.

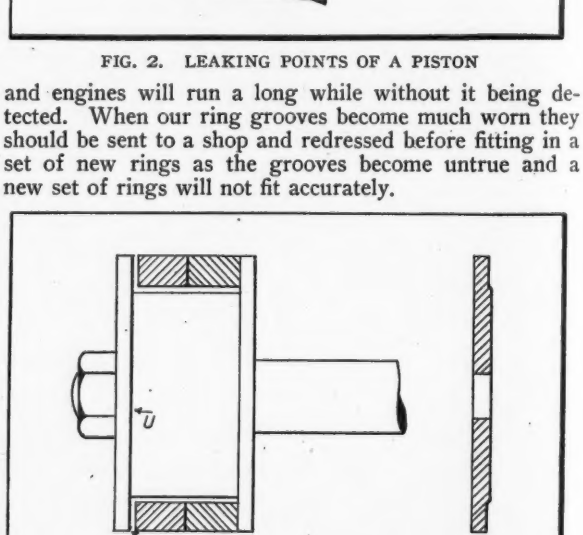


FIG. 3. LEAK IN PISTON VALVE
FIG. 4. SHAPE OF A WORN VALVE FLANGE

We have another example in Fig. 3 that is the rings on our piston valve engine. This kind of a leak will often become quite serious and waste many tons of coal. The rings will become much worn and have a play at the point

N, allowing steam to blow by and this is one of the cases that we do not see unless we make some search for it. The fact of an engine running does not signify that it is not leaking badly and we should open up our engines and put steam on to see how much blow we have in our working parts. A leak like this can be closed up by sending the valve parts to some nearby shop and having the head turned back at the point U, which will bring the valve head up against the rings. These flanges sometimes get in the shape as shown at Fig. 4, the rings will bear into the side of the flanges, and in this case this head should be dressed across the face so that we will have a true surface for the fitting of the rings.

It is useless to put a new set of rings in a valve head that is much worn as we will be little better off than before we put them in, as this untrue surface will not fit the ring properly and well. We cannot make a close fit to an uneven surface. Our piston rings, valve rings and valves do not receive the proper attention.

C. R. McGahey.

UNIQUE METHOD OF REVERSING AN ENGINE

WHEN erecting a small upright throttling engine one day not long ago, a funny incident happened which shows how even the best of men will sometimes get things twisted. The engine was set up all right and my assistant, whom we will call Mick because that is not his name, was left to start up. He gave her steam and she went all right but in the wrong direction; as I was called away just then I told him to reverse her and get the belt ready so that when I got back we could start up the machinery.

I was gone about an hour and when I got back Mick was just putting on the big belt, and said I, as I gave him a hand to put the belt in place, "Mick, did you reverse the engine," He said, "Yes, I did, and it's all right now." So I stepped over near the main shaft and told him to turn on steam.

He carefully opened the throttle and she started all right,—but still in the wrong direction.

"I thought you said you reversed it," said I.

"Well," said Mick, "by gad I did. I gave that governor belt a half twist and she ought to go the other way."

Another incident which was funny to the outsiders but not to the man concerned, came up in the boiler room where we have installed a Lagonda automatic safety stop valve on top of the boilers. We were cutting in another boiler and it had got a little ahead so that the valve was just, not quite, almost, hardly, balanced against the weight of the spring, when into the engine room came a fireman with eyes big as saucers and lips white as chalk and saying between shattering teeth:

"Chief, the safety valve lever on the side of that big valve up there is jumping up and down like an Indian on the warpath. Will she blow up if it comes off?" It took 20 minutes of drawing a diagram and explaining the action of that valve before the fireman could be persuaded to go back to the front of that boiler and be easy in his mind. A. Reader.

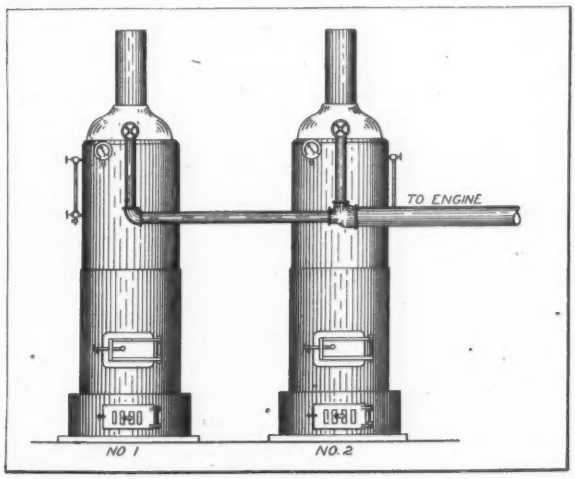
STRANGE

A FRIEND of mine, engineer at a large plant, told me of a boiler cleaner who came to him one day and said, "It's a wonder every drop of water didn't run out of that boiler yesterday because the crab that holds the front manhole cover was busted when we started to open it this morning. Can't see what kept it from falling in." E. C.

A VIBRATING STEAM PIPE

ILLUSTRATED herewith is a pair of large vertical boilers that supply steam for an engine. When both boilers are used the steam pipe is satisfactory, but the engineer wants to lay off one, at least a portion of the time, and it is possible to make steam enough with the other when the load is not excessive. This plan works well when No. 1 is in service, but when an attempt is made to use No. 2 alone, the steam pipe vibrates badly, hence there is danger of causing a rupture in some of the cast-iron fittings, that would not only permit steam to escape suddenly, scalding everybody near it, but would be dangerous otherwise, on account of suddent reduction of pressure.

Analysis of the conditions shown by the illustration will show the cause of trouble here. When the stop



PIPING WHICH CAUSES VIBRATION

valve on No. 2 is closed, steam is drawn very rapidly through the stop valve of No. 1, also through the comparatively small vertical and horizontal pipes until the reducing tee in front of No. 2 enlarges the passage and the volume is increased accordingly. This heavy draft occurs while the engine cylinder is taking steam, or during about one-quarter of the stroke, and the pressure in the above mentioned pipes is lowered slightly by it. Steam is taken from the extreme end of the pipe to make good the deficiency thus indicated, and when the cut-off valve closes the full pressure is quickly restored without excessive shock or jar. When both boilers are in operation, the rush of steam into the reducing tee shown, is not so great from either source, as their combined capacity is large enough to do it easily.

Laying off No. 1 boiler introduces different conditions, as follows: Closing the stop valve creates what is known as a "dead end," consequently when the engine cylinder takes steam the vertical pipe from No. 2 is not sufficient to maintain full pressure. As a natural consequence some steam comes out of the dead end mentioned, and as the source of supply is cut off, it cannot be raised until the cut-off valve of the engine closes, and it flows back from the larger pipe shown. When this backward action takes place, the steam is not cushioned against a body of steam in No. 1, but strikes a closed valve, hence a shock is given and repeated steadily until the whole line is

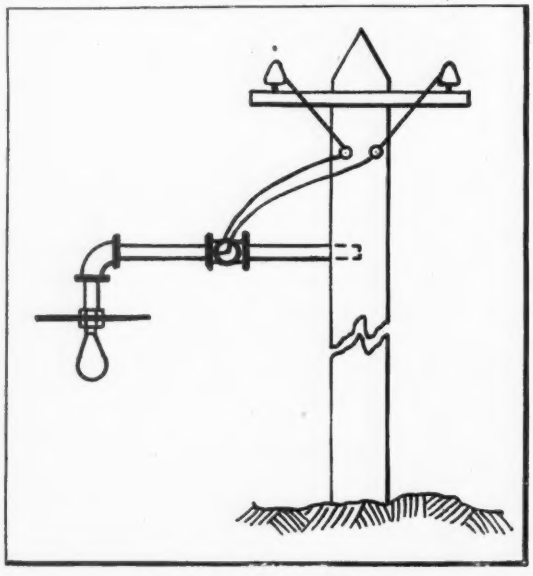
vibrating dangerously. Of course, the above mentioned action takes place very rapidly, for if the engine revolves 90 times per minute, it would cause this sudden rush to take place 3 times per second.

If the horizontal pipe between the 2 vertical pieces was larger than the main pipe to the engine, it would create a reservoir for steam, out of which a supply could be taken without reducing pressure. With a steam pipe 6 or 8 in. in diameter this header ought to be 10 or 12 in.

Another remedy is to put an extra valve in the horizontal pipe at the left of the reducing tee in front of No. 2. This would prevent the objectionable features of a dead end, but there is an element of danger in the operation of such a valve, for when closed, water is sure to collect between it and the stop valve of No. 1. If this valve is opened under such conditions, and this water is brought into contact with steam in the main pipe, it will cause dangerous water hammer. It is only necessary, however, to shut both stop valves, then open this extra valve and drain the steam pipe, open both stop valves slowly, if both boilers are wanted, but if only one is required open that stop valve, and when the pipe is thoroughly heated the extra valve will, of course, be left open to use No. 1 or closed if No. 2 is wanted. It is safer to install a header and have but 2 valves to operate. W. H. Wakeman.

HANDY HOME-MADE LAMP SUPPORT

IN the accompanying illustration is an arrangement I devised for fastening an incandescent electric lamp to a pole for outdoor use. This is made of ½-in. pipe with a cross a short distance from the pole into which the wires are lead, one on each side. The shade is made



LAMP SUPPORTED ON POLE

of bright tin secured between 2 nuts and the light is drawn up tight to the pipe to prevent it from swinging.
M. W. Epperson.

CORLISS VALVE CHANGES

IN regard to the trouble that T. H. Tucker is having with his Lane-Bodley Corliss engine, taking his cards into consideration, it looks almost impossible, without changing the valve gear or some part of the reducing motion of the indicator, to obtain cards like those from any one engine by simply changing from non-condensing to condensing, for the lengths of the 2 cards are different.

He also states he had 25 in. of vacuum; on the card it does not show 25 in. or anywhere near it.

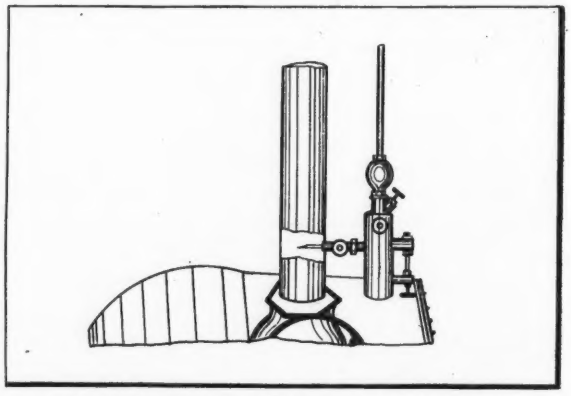
He does not state whether he has a single or double eccentric Corliss, but considering it to be a single eccentric, I will make the suggestion of measuring the clearance to see if it is equal on both ends, also see if the travel of the wrist plate is making the extreme marks on the hub at each stroke.

I will say in regard to adding more compression I think he has too much already, and that is the cause of this knock on one end, for it is not equally divided between the ends of the cylinder, the crank end shows too much and the head not quite enough.

Another point I will mention is the steam line; it is drawn more on the low pressure than it is on the high. That is a point which is hard to explain without knowing the conditions which the engine is subject to, it could be caused by a steam main too small for the size of the cylinder, also a slow opening of the valve. Frank Horr.

LUBRICATOR KINK

MY engine developed a groan in the cylinder, and the remedy I resorted to was to take the tail pipe of the lubricator out, drill a hole in the end ½ in. deep, take a piece of small tubing, made it spoon-shaped on



LUBRICATOR WITH ATOMIZING ATTACHMENT

one end and drove the other end into tail pipe, it being long enough to reach the center of steam pipe. The groan stopped and has never come back. With this addition the oil would go out on the flat surface and the impact of the steam would atomize it so it would thoroughly mix with the steam. N. W. Duell.

SAFETY VALVE VS. GAGE

SOME years ago the head miller of a flour mill had a call to overhaul and put in shape a mill in a Missouri town. While the mill was under the process of repair the boiler had to be repaired by a patch. After the repair was made and everything in readiness the weight and lever safety valve was set to relieve at 70 lb. pressure.

The engineer, with the assistance of the boiler maker, started a fire and raised the pressure to 20 lb. when the safety valve acted; the ball was shoved out to the end of the lever, but the gage did not show any more pressure but the safety blew off, so the wise men added more weight, to no effect. Now the engineer became desperate and thought it about time to do something, so he did. He clambered on the boiler and mounted the safety lever

and at the same time shouted to the boiler maker to "give her hell," and he did. Mr. Engineer hadn't long to wait for results, for there was an explosion that wrecked the whole mill, not even a shoe-string of the engineer's could be found. The boiler maker was killed instantly, but the owner of the mill who stood in the door of the boiler room was picked up by the sudden rush of air, carried 150 yards and set in his own yard unharmed.

The many boiler disasters should teach every engineer to think, for if there is any class of workman that should learn to think, it is the engineer. Although we may not get the pay we think we earn, that is no excuse for ignorance. We should read every reliable article that we can get time to read on subjects pertaining to our work, and observe and study every piece of machinery that we see. In this way a training is secured which will enable the mind to solve difficult problems that the more easy going will wonder at. J. G. Brown.

SOME FREAK CARDS

HEREWITH are cards taken from various engines which will serve to test one's Yankee capacity for guessing.

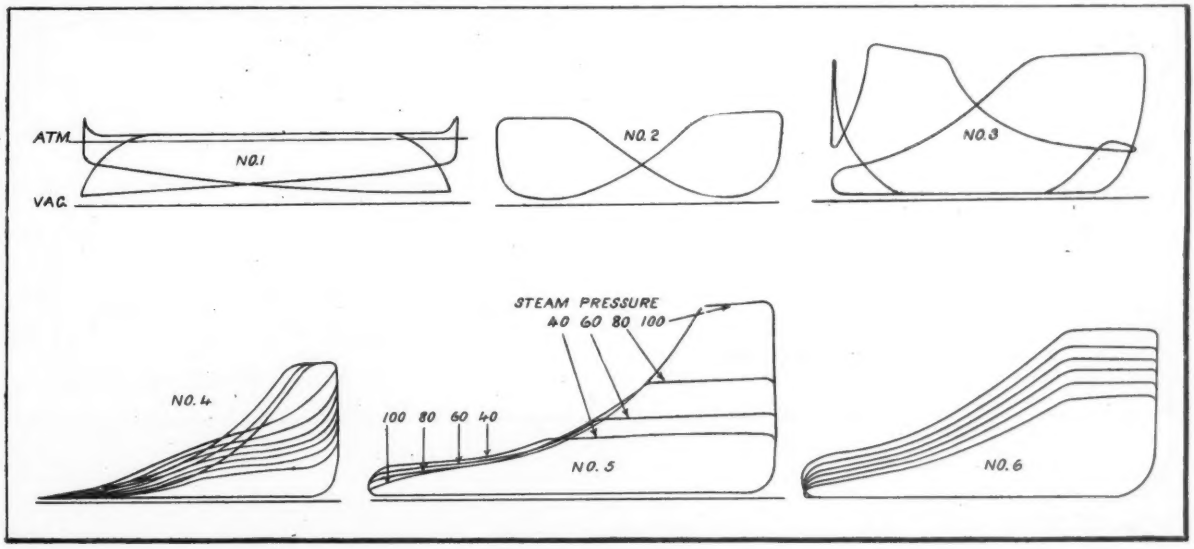
Number 1 was taken from a Putnam engine immediately after the throttle valve was closed and shows how the advancing piston made a partial vacuum.

DRYING KILN

THE unsatisfactory results P. L. Hatch reports he is getting from his apology for a lumber dry kiln described in the August issue of the Practical Engineer is not so bad after all when you consider the equipment. The only thing that makes one wonder is how he succeeds in producing the results he reports, for anyone familiar with modern methods of drying lumber would not expect or attempt to do even as well.

To find some one that could tell him how to regulate that thing would be as difficult as pulling hens' teeth, and in suggesting a remedy aside from abandoning the old thing entirely and building a dry kiln that is a dry kiln would be to increase the ventilation by removing the roof entirely and give the sun a chance.

Seriously speaking, 1, 2 and 3-in. green basswood can and ought to be dried in 4, 8 and 12 days, respectively. Thus you can see that he has no kiln when you consider that it requires 6 to 8 weeks, and then is not satisfactorily dried. The success of lumber drying does not depend on the great ventilating capacity a kiln is equipped with, as he seems to think, judging from the size ventilator with which his kiln is provided. Too much ventilation through cracks and crevices is found to be the rule rather than the exception due to poor construction resulting in reducing the effiiciency of the kiln. A tight kiln in which the ventilation is absolutely under the control of the operator is very essential in speedy lumber drying. This also applies to the heat furnished for the kiln.



INDICATOR HIEROGLYPHICS

Number 2 is a freak secured by an error from a Corliss engine piping carried from both ends with both indicator cocks open.

Number 3 is taken from a Corliss engine and shows the conditions when the exhaust rod on a Corliss valve motion is made too long.

Number 4 is from a Putnam engine showing the conditions with the throttle valve being gradually opened while coming up to speed and a continuous card being taken.

Number 5 shows the effect on cutoff and terminal pressure in a Corliss engine as the boiler pressure is increased.

Number 6 is a card from a riding cutoff engine, showing how the steam pressure changes with load while the cutoff remains the same. Governing was by means of a throttling governor. A. C. Waldron.

In the above case, figuring from the meagre information, we would say that the heating surface is entirely inadequate, and should be increased at least 300 per cent. More detail information about the construction of the building would be required before it could be determined if it would be advisable to do so in his kiln. The coils also would require remodeling and probably their location changed.

We are of the opinion that a new and properly constructed kiln, the size of which being determined and based on the amount, kind and thickness of lumber to be dried, would be preferable and would be the only proper solution.

The principle in drying lumber successfully and speedily lies in the maintenance of a high temperature

and humidity, which must be absolutely under the control of the operator. E. H. Sonneman.

JUDGING from my experience with dry kilns and drying rooms, Mr. Hatch's trouble is due to improper location of the vent. By the use of a mirror it can be demonstrated that air containing the most moisture stays from 2 to 4 ft. above the floor. The principle of drying is to remove the moisture and not the heat, the vents should, therefore, be placed on all sides from 2 to 4 ft. above the floor and not in the roof as his is, for then the hot air escapes, leaving that containing the most moisture in the kiln. R. A. Robbel.

REFERRING to the question asked by Mr. Hatch in the August number of the Practical Engineer, I would suggest first, that he rearrange his heating system so as to secure better circulation.

This could be accomplished by using a larger steam main taking branches off for each bank of pipes.

And he should close up that ventilator and erect a large bank of 1-in. pipe for cold water circulation. The moisture driven out of the wood readily gathers on these pipes and is carried away, as it drips down, by a suitable trough leading to the outside.

By the use of this method the kiln can be forced a great deal with very little waste of heat.

H. Y. Baldwin.

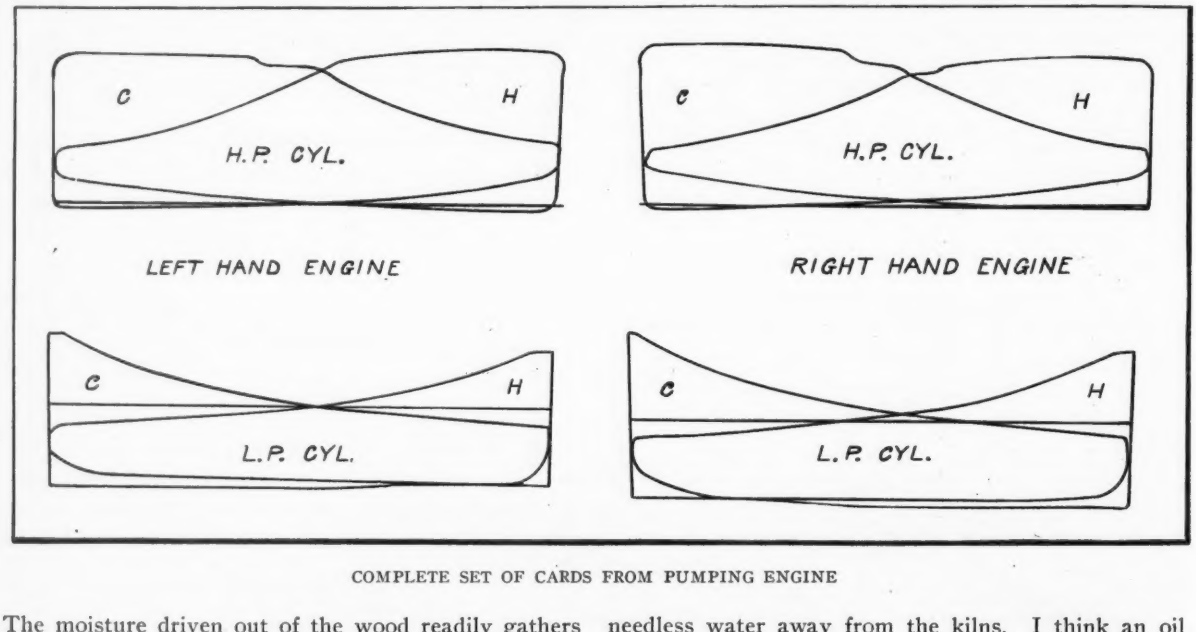
DRYING PRACTICE

I WAS much interested in a letter signed Charles Burns which appeared in a recent issue of the Practical Engineer. I have had some experience in drying lumber and various other materials and understand the theory of drying anything to be that the air at a given temperature will hold a certain amount of moisture, and, when that state is reached, it had better be discharged at once. If the above is true, it is plain that a rapid change of air as well as a high temperature and initially dry air is needed.

A great many times I have been called to rooms where the foremen had complained that they were unable to dry the material, and all I did to remedy matters was to open a way for the hot, saturated air to escape. At one place where I was employed, a fan sent a current of air through tubes in an open heater and thence to the kilns. The fan was not allowed to run fast enough to lower the temperature of the feed water. At another place, I found a live steam heated, home-made coil furnishing dry air, which was driven by a fan. After I was there a short time a Sturtevant system or coil of pipes using exhaust steam and fan was installed and gave splendid satisfaction. Another place had coils on the floor, using live steam. This also was changed later to the same system.

At the plant I am now running we have several large rooms with coils around the side walls, carrying steam at boiler pressure, and no air vents provided (aside from broken windows). I have endeavored to persuade the superintendent to let me try the Sturtevant system, but with no result, as yet.

To come back to Mr. Burn's letter, I think it would be wise to run the 3-in. pipe inside of the kiln, by all means. If the foregoing theory of drying is correct, it is self-evident that it would pay well to keep all needless water away from the kilns. I think an oil extractor should be placed on the exhaust line from the engine and a pump installed to pump the returns back to the boiler. I have known of instances where it was considered cheaper to burn the refuse than to cart it away. Perhaps this is the case where Mr. Burns is employed. E. B.



COMPLETE SET OF CARDS FROM PUMPING ENGINE

CARDS FROM PUMPING ENGINE

ACCOMPANYING set of indicator cards is for criticism by readers of Practical Engineer. The cards were taken from a compound condensing crank and flywheel pumping engine, made by what was at that time the Holly Manufacturing Co., of Lockport, N. Y. The engine is composed of 4 cylinders, 2 high-pressures and 2 low-pressure; the high-pressure cylinder being placed on top of the low-pressure cylinder, with the cranks placed at 90 deg.

I would appreciate criticisms from readers of Practical Engineer who have charge of such a machine. The pump has a capacity of 3,000,000 gal. in 24 hr.

W. P. F.

"SOME" ENGINEER

HIS name is not "Jones" but that's what I am going to call him—it is perforce and not intention that I must inflict another "undesirable" on that already over burdened and sorely-tried family, and humbly, then, I ask their forbearance.

Although with an understanding of the mysteries of a steam engine that encompassed barely more than the opening and closing of the throttle, Jones was conceded the mechanic of the neighborhood, and to him was accorded the privilege of operating the few steam threshing outfits that had at one time or another, found their way into his district.

Strong with the scoop, he delighted to see the smoke roll in clouds to the hills; but a hopeless inability to negotiate the simplest repair had no tendency to disturb nocturnal slumbers so long as the old "mill" turned over with a semblance of regularity.

"In the course of human events," there came into the Jones family one venerable traction engine of voting age, decrepit and squeaky, destined to wheeze out the remainder of its weary existence under the skillful guidance of our Mr. Jones.

For a while things went well with the new arrival, but about 2 o'clock one morning Jones, on his way to a new "setting" for the next day's threshing, endeavored to make up some lost time with the result, that half way up a hill, the babbitt in the crank box, not accustomed to the "hurry," severed its connection with the rest of the outfit. Realizing his usual helplessness, one of the crew was despatched to a nearby "ingineer" with a "C. D. Q." message to come and run the "blankety box" for him; in the meanwhile, the damper was forgotten, the steam pressure soared, and the safety valve stuck, which it usually did, when by some lucky chance the steam pressure got near the blowing off point.

Now I knew Jones very well, shortcomings and all, so the next time I met him I asked what he did when he found the safety valve stuck. "Well," replied Jones, "I just climbed up on the biler and swatted that pop a crack or two with a wrench an' say," he continued, "when at last that pop valve did let go an' I had got back and took a squint at that steam gage, how much pressure do you suppose was on that biler?" "Considerable, no doubt," I answered. "Yes sir, there was just 525 lb. on that there biler as showed by the gage an' I guess that's some pressure for a biler of that kind all right, all right." "Well yes," I replied, "and that gage must be 'some' traction engine gage, too." Eddy Current.

CORRECTION NOTE

I NOTE in the quarter turn belt drawing on page 639 of the September issue the arrows on the right hand figure point the wrong way. The arrow on the vertical belt should point up instead of down and the arrow on the lower pulley be reversed, the pulley will then run in the same direction as shown in the left hand sketch. The belt leading to a pulley must be straight and the one running from that same pulley will be the angle, hence the left hand sketch (including the arrow) is correct. Wm. S. Luckenbach.

ON SEPT. 5 the Nelson Valve Co. held its annual dinner to officers and heads of departments at its works, Chestnut Hill, Pa. An extended program of delicacies and witticism was followed by discussion of the interests of the company, and whole proving a most enjoyable and profitable evening in every way.

FINDING TROUBLES

IN the practice of steam engineering, we often find a small trouble which by a little reasoning leads us to a greater or more serious fault which has caused the little one. For example, we have seen large runs of steam pipe which are leaking in the thread, and the engineer may at once proceed to calk the leak or put an adjustable steam clamp on it to stop the leak,

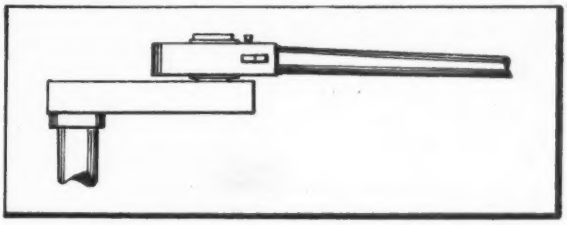


FIG. 1. EVIDENCE OF BAD ALINEMENT

when really the cause is from poor judgment in allowing for expansion, or excessive vibration, or lack of threads made into the fitting.

Referring to Fig. 1 will be seen the hint which a connecting rod strap will give that the crank shaft is not square with the line through the cylinder. As

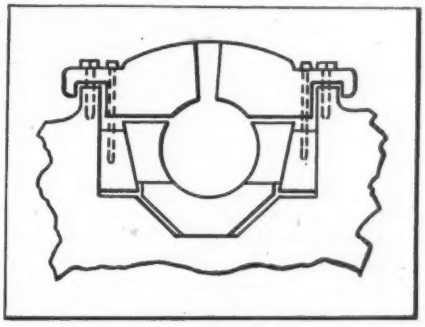


FIG. 2. MAIN PILLOW BLOCK WHICH CAUSED TROUBLE

shown, the position is somewhat exaggerated, but the wear on the strap and the bind will show that the connecting rod is out of line with the crank shaft.

The second illustration shows the cause, the main pillow block. It is easy to see that by taking up on one of the wedge blocks more than another the

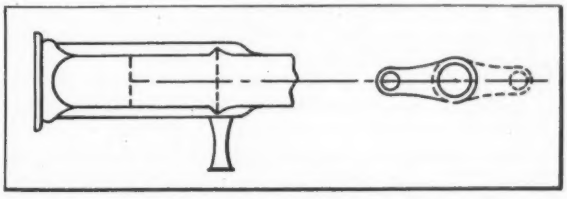
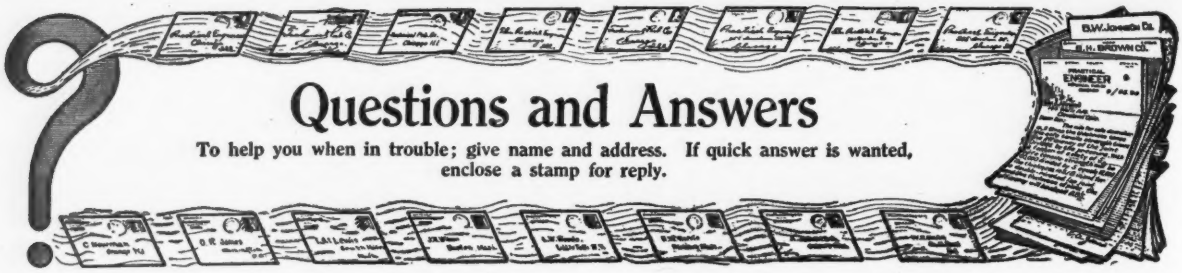


FIG. 3. LINING THE CRANK SHAFT

shaft was forced out of line without realizing it. The engine had V-shaped guides, so I took off the connecting rod and pushed the crosshead hard up to the cylinder, then put up 2 plumb lines, between centers of the V guides, and a horizontal line as shown in Fig. 3, and made the crank fit square on the horizontal line on both head and crank ends by adjusting the take-up wedges in the pillow block Fig. 2. By putting shims under the bottom box. I made the crank shaft level. While this is not the accurate way to line up an engine, it served the purpose nicely and gave no further trouble. A. C. Waldron.



Questions and Answers

To help you when in trouble; give name and address. If quick answer is wanted, enclose a stamp for reply.

THE CHIEF ENGINEER'S CATECHISM VI

WHAT is meant by the term "combustible" and why is it used?

2. Is natural or forced draft better suited for high efficiency combustion?

3. Do you prefer the pressure or gravity system for feeding oil to a boiler furnace and why?

4. What is the average cubic feet of natural gas required to evaporate a boiler horsepower?

5. Under what conditions would you set a boiler high above the grate bars, and under what low?

6. What is the use of a combustion chamber and do you prefer to have it high or low, deep or shallow?

7. Will the same furnace, stack and draft answer for all bituminous coals?

8. Is an absolutely pure water desirable for boiler feed?

9. What is boiler scale as usually found? What kinds and of what composed?

10. What percentage of carbonate should a good feed-water heater remove?

(The best set of answers to these questions will be paid for at the regular rate, and the author of the second best will receive a prize of $3. Answers will be published in December issue, and all answers should reach Practical Engineer not later than November 1.—Editor.)

Three-Ring Packing

WHY is it that a 3-ring packing is not more commonly used for piston and valve rods? The question has been raised and it seems to be a fair one, as this style of packing has proved itself able to give good service.

Flow of Water

IT is desired to pump 100 gal. of water a minute through a 6-in. pipe 1 mile in length against a hydraulic head 413 ft., friction not included. What is the velocity in feet per second? What is the friction head and what horsepower is required? H. P.

A. As you are in an English colony we assume that you have used the Imperial gallon, which has 0.16 cu. ft. to the gallon. In this case 100 gal. would be 16 cu. ft. The area of a 6-in. pipe is 0.205 sq. ft., and to pass 16 cu. ft. a minute would require a velocity of 16÷0.205, = 78 ft. per minute, or 1.3 ft. per second.

Weisbach's rule for the head lost by friction is as follows: Multiply the constant 0.00644 by 4 times the length in feet, times the square of the velocity in feet per second. Divide this by the diameter of the pipe in feet and by 64.2.

The length of your pipe is 5280 ft., the diameter of the pipe ½ ft., and the velocity per second, as figured above, 1.3 ft. This works out to 7.16 ft. as the friction head. Adding the 413 ft. of hydraulic head gives 420.16 ft., and to raise 16 cu. ft. of water weighing 62.5 lb. per cubic foot against the head of 420.16 ft. would require 16×62.5×420.16÷33,000=13.1 horsepower.

ANSWERS TO CHIEF ENGINEER'S CATECHISM IV

Smoke, Feed Water Impurities, Pumps and Valves

By F. O. Wells

SMOKE is caused by the volatile gases not having a sufficient supply of air to make a thorough mixture with the gases while passing over the heating surfaces. This may be due to bad firing, poor quality of coal, or to excessive forcing of the boiler. To prevent this, the firing should be light and frequent, only firing about one half of the furnace at a time and the fires maintained at the best depth to insure good combustion, with the draft at hand. An ideal air supply is obtained by having a little excess air supplied automatically after the fresh fuel is supplied and cut off as soon as the volatile gases are consumed. Excessive smoking may be caused by forcing the boiler and this can only be overcome by having sufficient boiler power to supply the demand. A poor grade of coal, which is high in volatile matter, may be the cause and with this grade of coal more air should be admitted above the grates.

2. The appearance of smoke at the chimney-top is not always indicative of serious loss, nor is its non-appearance always proof of good combustion. With soft coals and other fuels containing the hydrocarbons some smoke usually accompanies the best practically attainable conditions, charcoal and coke never produce true smoke. Attempts to improve the efficiency of a heat generating apparatus by "burning the smoke" usually fail by introducing such an excess of air as to cause a loss exceeding that before experienced from the formation of smoke. In this case, combustion will be complete, but the heat generated will be distributed throughout the diluting excess of air and thus rendered less available, and the efficiency of the furnace correspondingly reduced.

3. In many cases the chimney consists of a simple pipe of sheet iron rising directly from the flue, which, forming a part of the boiler setting, also serves as the base of the stack. This type of stack permits a loss of heat and cooling of the air column and is known as a cold air stack. In the majority of cases a brick stack is preferred, both on the score of permanence and on that of better draft. This is known as a hot air stack as the column of heated air is not cooled to any observable extent.

4. Permanent hardness is caused, as a rule by the salts of magnesium and calcium other than the carbonates, such as chlorides and sulphates, which are soluble in water and are, therefore, not thrown out by simple boiling. Permanent hardness can be reduced by chemicals, such, for instance, as washing soda or sodium carbonate, for both the sulphates of calcium and magnesium are decomposed by it, insoluble carbonates of calcium and magnesium being formed and sodium sulphate taking the place of the original sul-

phates in solution. "Clark's process" of softening water is to add lime in order to effect combination with CO_2 in the water, just as occurs when CO_2 is driven off by boiling. Ordinarily one ounce of lime per 100 gal. for each degree of hardness is added.

5. An analysis should be taken to determine the proportion of scale-forming constituents in the water, this being known, a proper proportion of chemicals or compound to bring the water to practically a pure and neutral state, can be determined.

6. The object of the live steam purifier is to purify the water by simply holding the water in the purifier, for a sufficient length of time, to permit it to be heated to nearly the same temperature as the steam. This heat causes the precipitation of the carbonates and other salts. By precipitating these salts here, the heating efficiency of the boiler is not affected.

7. The speed of pumps for best efficiency is as follows:

Centrifugal pumps, 200 to 250 r. p. m.
Air pumps, 200 to 350 ft. p. m. piston speed.
Feed pumps, 30 to 40 ft. p. m. piston speed.

8. All feed pumps should be of the best possible construction; should, when possible, be in duplicate and of far greater capacity than is demanded in regular work. The area of the steam piston should be from 2 to 3 times that of the water piston and the valve gear should be of such type, as to permit full port opening the entire length of stroke, cutting off sharply at the end of each stroke.

9. Feed checks are placed next to the boiler unless a stop valve should be used, in which case, the stop valve should be placed next to the boiler and the feed check bolted to the stop valve. This permits examination of the check valve when steam is on the boiler. The object of placing a check valve here is to prevent the hot water and vapor from backing up into the pump and thus causing a faulty action of the pump.

10. The placing of these valves would depend largely on the type of boiler. The bottom blow valves should be placed at the bottom of the mud drums or at such places as the circulation of water might deposit the sediment in the water. The surface blow should be placed on the steam drum, at about the water level, with an internal pipe and scum pan, so that in using, the surface of the water would be scummed. I consider the Johnson-Nolan type as the most efficient. This valve is easily operated, and from its construction, leaks are practically unknown.

By K. R. Smith

2. Not always. Sometimes the fire is in poor shape and has air holes down to the grate, so that the cold air draws up through the grate without aiding combustion and yet does not make any black smoke or steam either, and the gases go up the stack and cool off the boiler.

7. The piston speed of a boiler feed pump should not exceed 100 ft. per minute, and slower speed is advisable to do good work for there will be less slip of the valves in seating each stroke.

8. Be sure that the plungers, valves and suction pipe are tight and there will be very little trouble. Most of the trouble comes from the water end of the pump caused by leaking valves and plungers.

9. The check valve is put on to stop the water from flowing back when the pump is stopped. A check valve should be placed in the feed line to each boiler in an accessible place so that one can get at it if it gets out of order, and there should be a gate valve between the boiler and check. The swing check is best and gives a straight opening.

10. The place for blowoff valves is in a pipe line leading from the lowest part of the boiler or mud drum so as to blow off the sediment which collects there. A plug and gate valve combined is the preferable arrangement so that in case one gets stuck the other can be used, and when open they give a straight opening.

Draining Heating System

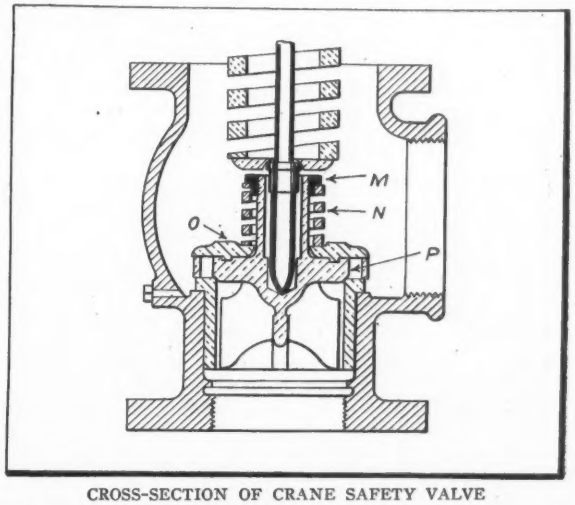
IN our heating system the lowest part of the radiators is only about 1 ft. higher than the water level in the boiler 150 ft. away. As the returns are piped back into the boiler, the radiators are constantly half full of water instead of steam, as I prefer.

Can anybody suggest an arrangement other than a pump by which the return can drain into a drum at lower than boiler pressure and be automatically delivered back into the boiler? E. A. S.

Crane Safety Valve Adjustment

PLEASE show how the "blow-back" is regulated on the crane safety valve. T. T.

A. The "blow back" of the Crane safety pop valve may be regulated by turning the adjusting nut M which governs the tension in the auxiliary spring N. This spring governs the pressure at which the cap O will lift when hit by the escaping steam entering through openings P, which are in the main valve at the outer edge of the seat. Being adjusted to a comparatively light tension, it does not offer a resistance which would tend to keep the valve open after the boiler pressure had dropped below that for which the valve was set. These valves are styled "self-adjusting," and it is claimed by the manufacturers that no adjusting need be given the auxiliary spring after it leaves the factory.



CROSS-SECTION OF CRANE SAFETY VALVE

Discharge Through Pipe

I WOULD like to figure the amount of water which can be forced through a 12-in. cast-iron pipe 2000 ft. long, outlet 16 ft. above inlet.

We are now drawing water with a duplex plunger pump. We wish to change the system and place a pump at the water level and force the water up into a cold well.

What I want to know is how much water I can get through the pipe at different pressures and how

much power it would require to maintain these different pressures. R. G. S.

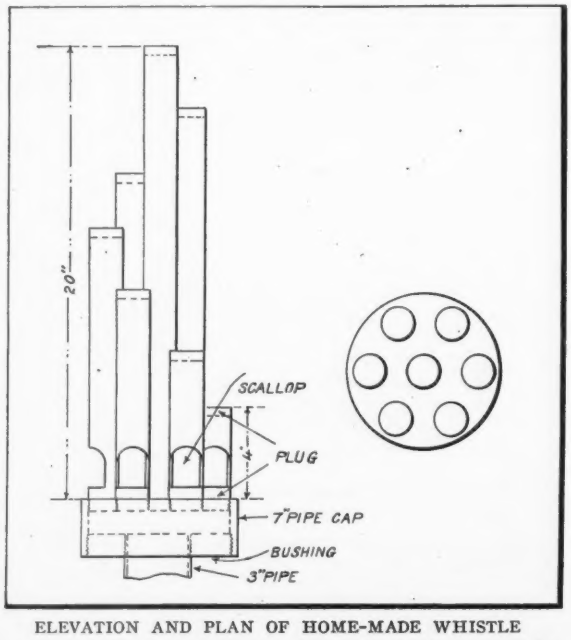
A. The rule for discharge of water through a pipe is as follows:

Gallons discharge per minute equals 2.83 times (the square root of [the head in feet, times the 5th power of the diameter in inches and divided by the coefficient of friction times the length of the pipe in feet]).

For a smooth cast-iron pipe of the size mentioned the coefficient would be about 0.05. In your case, substituting and carrying out the computation, we would have 142 gal. for 1-ft. head of pressure, and each pound pressure between the lower end of the pipe and the upper end would be equal to 2.31 ft. head. Of course, your pump must furnish, first of all, sufficient pressure to overcome the head of the water. After that any extra pressure supplied will go into spouting velocity, tending to increase the flow. If you ran so that the pressure at the pump was 30 lb., this would be equivalent to $30 \times 2.31 = 69.3$ ft. head. Taking out from this the 16 ft. of actual head of water gives 53.3 ft. to produce flow. The square root of this is about 7.3, which multiplied by 142 gives a total of 1036.6 gal. per minute.

Increasing Volume of Whistle

WE have made a steam whistle from steam pipe and a cap as follows: The whistles proper are made of 1½-in. gas pipe varying in length from 4 to 20 in., threaded on the lower end with a plug made to fit on the inside



ELEVATION AND PLAN OF HOME-MADE WHISTLE

just above the threads; 1/16 in. is filed off on the side next to the whistle opening for half the circumference of the pipe, which is the amount cut out for the scallop. The plug is bolted in place so that no steam can pass except what gets through the orifice. The top of the pipe has a plug riveted in it. The whistles are screwed into a 7-in. pipe cap which is extra strong, this cap having a 7-in. by 3-in. bushing screwed into it on the under side and steam is supplied through a 3-in. valve. The whistle has a very fine tone but does not blow as loud as desired. We carry 120 lb. steam pressure.

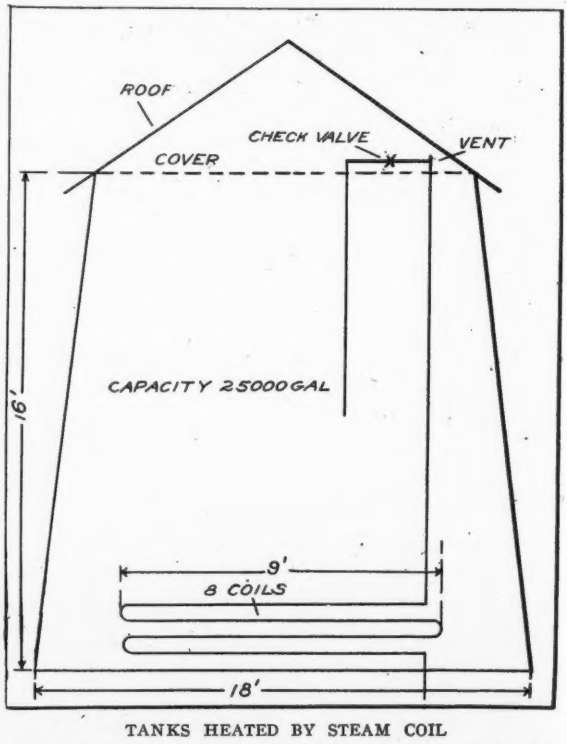
I believe that if the pipes were turned true on the inside a little above the upper edge of the scallop, then turned on the inside until the pipe was only 1/16-in. thick, the whistle would blow much louder. I would like to hear from any of the readers who can tell me anything that will help me out.

M. M. R.

Heating a Tank

I HAVE a tank holding 25,000 gal. of water which has to be heated about 80 deg. in winter to keep from freezing. It is located 100 ft. above the ground and is provided at bottom with a coil of 8 coils 9 ft. in length made up of 1 in. pipe with return bends. I have had trouble during the past winter in getting the water too hot at the top of the tank, but it is ice cold at the bottom and freezes up the pipe. Would it be better to put in a Lee water heater at the bottom so as to give a circulation throughout the tank? I have 1-in. pipe connection to the coil. R. E. K.

A. There is, without question, circulation of water so long as the steam is turned on, and presumably the freezing of your coils occurs only when steam is turned off. With a Lee water heater you would get some circulation, but it would be difficult to keep up circulation all over the tank, and the better plan would seem to be to put in a number of jets at various points



TANKS HEATED BY STEAM COIL

around the circumference of the tank near the bottom and permit these to discharge upward, thus inducing a circulation all over the tank. One difficulty with the heating of your tank is that the coils are too short in proportion to the diameter of the tank. It would be better to have 4 coils 18 ft. long, so that the water clear to the outside of the tank would be heated.

A still better arrangement would be 2 coils 18 ft. long across the bottom of the tank in one direction, and 2 other coils 18 ft. long across the bottom at right angles to the first coils.

STRENGTH OF FLAT PLATES

CALCULATION OF STRESS SET UP OR OF PROPER SPACING OF STAYS FOR TANKS AND BOILERS

THIS has always been somewhat of a puzzling problem and authorities have differed considerably as to the proper form of equation for strength and the proper rule for calculating the strength of such plates and the staying of flat surfaces required. In general 2 forms of equation have been employed: the form as given by the Board of Trade and the form as employed by Navier, Grashof and Clark, the latter being the simpler. As a matter of fact both give approximately the same values over the ranges of pressure at which experiments were conducted.

The Massachusetts Board of Boiler Rules has used the Board of Trade formula employing the constant 66 in calculating its tables, which is the constant for surfaces exposed to fire. For surfaces not so exposed the constant of 125 is recommended, so that the firebox plates are credited with about half the strength of those not so situated.

There has been considerable question as to the correctness of the constants given by Grashof, and experiments have been conducted at Rensselaer Polytechnic Institute by T. A. Bryson, looking to the verification of the constants of the equation. Mr. Bryson explains the experimental work done which consisted of tests on plates held at the edges, plates being tested having spans of 18 by 18 up to 24 by 24 in. and ranging in thickness from ⅛ to ½ in. Steel plate was used in all cases. The equation deduced from the experiments is of the form given by Grashof and becomes

$$S = \frac{Ca^2p}{t^2}$$

in which S = the stress set up, C is a constant depending on the ratio of breadth to length of the plate, a is the length of the short side of the plate, p the pressure in pounds per square inch and t the thickness of the plate in inches. The value of C is:

$$C = \frac{0.5}{H - \frac{2.55a}{b}}$$

in which a is the short side and b the long side of the plate or a÷b is the ratio of the short to the long side.

The experiments made show that values of C vary with this ratio according to the curve shown in Fig. 1. The equation solved for the length of the short side becomes:

$$a = t\sqrt{\frac{S}{Cp}}$$

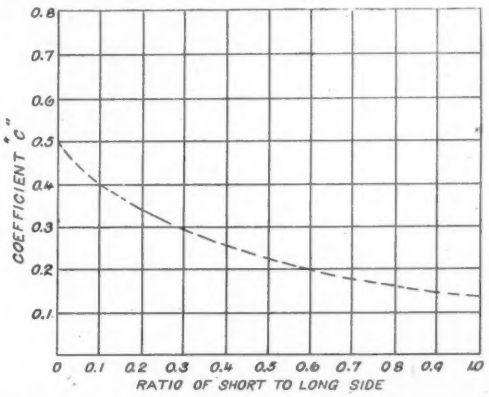
in which the symbols are as before, or, put in the form of a rule:

Divide the safe stress in pounds per square inch by the constant and pressure in pounds per square inch, extract the square root of the quotient; multiply this by the thickness in inches and the product will be the distance of the short side of the plate in inches.

Of course, for the ordinary method of spacing in which the stays are in square arrangement, both sides of the supported plate are of the same length. The constant under such a condition is 0.141.

This equation can be put in the form of a graphical diagram which makes it simple to read and the result is given in the Practical Rules and Tables Sheet. In order to use the diagram as there given, start on the axis marked "Thickness of Plate," with the right thickness in inches, pass horizontally to the left to the intersection with the diagonal of boiler pressure, then vertically upward to the intersection of the diagonal showing stress of the plate, then horizontally to the right to the line showing the ratio of the short side to long side of the plate, then vertically, downward to the axis showing the proper distance between staybolts or supports on the short side. For the common staying arrangement the usual ratio will be 1 to 1. If the plates are in the firebox exposed to the action of the flames, the spacing distance thus found should be divided by 2.

The author states that for plates which are simply supported at the edges and not fixed, the constant C will have a value 1½ times that for the fixed plates.



VALUES OF C WITH VARYING RATIO OF SIDES OF PLATE

The values as given are for soft steel but within the range of practical data would probably be safe for wrought iron. The equations are stated to be safe for thicknesses from ⅛ up to ¾ in. and for the ratios of the short side of the plate to thickness running from 50 to 150. It thus covers practically all cases encountered in actual work.

"THE MAN WHO tries and fails may often times be excused because of his attempting that for which he was not prepared, but often times the unprepared man gives up when failure seems to be hanging over his head—he is a quitter and is shunned by his fellow men—it's hard to respect the man who has lost faith in himself and it's few who do respect him. Often times a few encouraging words from a close friend prevents a man from letting go his hold on this life, if we could but know when a man is ready to quit, a great many, so-called, failures would not be—but the line between success and failure is so fine that at certain times one never knows upon which side his shadow falls. Failure which comes from giving up hope is merely the evidence of manhood which is lacking, manliness is one of the most respected virtues which we may possess, it will with the help of health and industry bring that prosperity which so many men desire; so create it, cultivate it, should it not be inborn, and thus prepare thyself against those things which make out of man—a quitter."

LETTER FROM AN OLD ENGINEER TO HIS SON

THE OLD MAN'S IDEAS ON USING A TECHNICAL EDUCATION

MY dear Son:

Your welcome letter of a few weeks ago was duly received, and I am glad beyond expression to know that you graduated from the Burgville Technical Institute with so good a standing. Of course, it is nice to be at the head of the procession, but when the procession has eighty odd rattle-brained rah rah boys in it with balloon pants rolled up over their shoe tops exposing red and purple sox and wearing eye-glasses made of old window panes, why, third from the top is not so bad at that.

To come right down to facts, it isn't the man who is drum major of this life's educational procession that eventually makes good with a bang. The bass drummer is the last man in the band, but please note that he is usually hammering away at the same old drum after all the other musicians have quit playing and the drum major has tucked his fence picket with a croquet ball on the end under the arm of his gaudy coat, shakes his great white plume and looks wise.

Leading the procession doesn't count for much except with the ladies and newspaper reporters, for usually by the time the real workers pass in review both the dear things and the scribes are horribly bored. The late Gen. Robert E. Lee stood so high in his average at West Point that they almost had to raise the limit from 100 to 105 to make room for him. Gen. U. S. Grant was away down near the bottom of his class. In fact, when the war broke out he said he "thought" he could command a regiment. Well, we all know now that he was fully capable. So my son, don't think that because you are number three with an average of 99-44/100 pure, like laundry soap, that you are going to stand 99.44 all down this vale of tears just because you had a good start.

Sometimes these factory-made men strut down the pathway of life with such a rush that they soon run out of breath, and while they are sitting down under the shade-trees, where Main Street passes Bighead Boulevard, to catch their wind, the bunch gets by them; in fact lots of them never get their second wind and have very little of the first except hot air. Do you remember Jim Grogan who was defeated for Governor on the Democratic ticket when you were still going to the district school out at Sussex? Well, he was that way. He got up steam under forced draft, screwed down the pop till the boiler swelled out like a balloon, pulled the throttle wide open and started out with a rush. He reminded me of a sky-rocket. Somebody headed him in the right direction, touched him off, and up he went in a blaze of glory, while the admiring throng gazed in open-mouth wonder. The rocket burst with a thousand varicolored stars and the entire world exclaimed "Ah!—He's the coming man, watch him!" But, when election day was over and the stars died out, the cheering multitude soon forgot,—and the charred and blackened rocket tumbled to earth from a dizzy height and retired to oblivion forever. I saw in the paper a few weeks ago, that Jim Grogan died in poverty in a miserable hovel up in Pabstberg, down and out to the last notch.

Now you perhaps want to know what all this talk about Lee and Grant and Grogan has got to do with your contemplated profession as an engineer? Well, this is a very peculiar old world and we have but to look around us and see how the other fellow falls down, and then its up to us who come behind to avoid the mistake that he made and note the good qualities with which the successful ones win out, and use them for ourselves.

Grant stood low at the Point as far as averages went, but he had 2 qualities that the Point Commander didn't take into the averaging business. One was horse sense and the other was bull dog determination. If these had been taken into account, Grant would have stood so far ahead of the others that there wouldn't have been any second in the race, or third either—just first—fourth, fifth, etc.

So, my Son, when you get this far, just read it all over again, then go out into some of the little quiet spots around that town, sit down beneath the trees and think it over. Figure it out for yourself—you're the father of your destiny—figure it out whether you want to be a Jim Grogan and flare up and die out in a few brief months, or be a U. S. Grant, and 'fight it out in this line if it takes all summer.'

But, to get back to the main line again, Mother and I are both very glad to know that you did so well at school, also that you really got a good start. Now, don't let anybody grease the rail on you. If you feel the wheels slipping, put a little sand on the rail. You know locomotives carry sand to use when they lose their grip. Now you are a locomotive. True, you are a little one yet, just a little "dinkie" pulling the "sub" from Pabstburg to Springville. Two, nearly empty cars, 3 round trips a day, but still you need sand. When a locomotive runs out of sand, it is down and out; so is a man.

You have a pretty fair smattering of knowledge in your head by this time—(I hope), but—it won't hurt you any. The first thing you will do I suppose, is to make a flying start and try to land on the steam engineering ladder about 10 ft. from the top—(its a thousand miles high)—and try to tell old hands in the business how to do it, and how not to, and try to do everything the way the old professors showed you back in college. Now let me tell you, my Son, that just as soon as you try any of these get-there-fast stunts, you are going to come down kuplunk so hard that you will make a dent in a stone-quarry. There is no short cut to the top of the engineer's ladder. You have got to begin right down at the bottom, wheeling in coal and wheeling out ashes. Now, this doesn't sound very good to you my Son, Donald Cameron MacDougal, B. A., L. L. D., and perhaps M. D. and P. D. Q. for all I know, but it is true nevertheless just the same, so spit on your hands and go to it.

There are one or two other things I want to write you at this time, just in passing before I forget, and that is, the steam engineering business is a garden and its up to you whether you will be weeds, morning glories, or potatoes. What has that to do with ashes, wheelbarrows, condensers and engines, and—other things? Well, its this way. Weeds are prone to spring up in all manner of places and gradually crowd out everything that grows for a better purpose. You find human weeds all over. They don't live, they just exist. They make no progress, they never have a position, just a job, and some day the boss comes round and finds out they are just weeds and cuts them down right where their head fits onto their shoulders.

Then there are morning glories and other flowers. To be sure, they are very beautiful. In the springtime they bud and bloom, and fill the air with their fragrance, and create good cheer about them. But in the fall the first frost catches them and they are not worth five cents an

acre, unless carefully removed beforehand to the greenhouse, to save them for the next season.

Some engineers are morning glories. They come down to the plant with a boiled shirt on, a high collar, a tie made out of the rainbow, trousers with a crease in the front that would split kindling, and shoes of precisely the latest style. They play to the grand stand—(I never was to but one ball game in my life and somebody said something like this to the fellow out in the middle). They fourflush up to the old man and tell him what a bully good engineer they are, and all that rot, and the old man thinks because he looks good he is good. Pansy engineers can run a plant all right as long as everything is all summer and sunshine, but just as soon as something goes wrong and the powerhouse junk begins to move around promiscuously, then, well that's where they fall down. That is the first frost and the ambulance surgeon carts him off to the hospital (the greenhouse) for the winter till he gets rugged enough to stay out doors all his life and rough it so to speak.

Now for the potatoes. If you are going to be an engineer at all, be potatoes; not small potatoes, but good big ones. The potato engineer is the fellow that steps into the engine room quietly, dresses neat, clean and plain, and keeps the bugs off; occasionally he has a few delicate blossoms on (this is when he dresses up and goes to engineers' meetings, etc.) and when trouble comes (and mind you, boy, it comes to them all sooner or later), when trouble comes the old man finds by digging down and finding the large potatoes, that there was far more to the engineer than he thought from looking at the tops.

And the bugs? Oh, yes. Well there are lots of bugs that kill the tops (the general appearance) of an engineer, and spoil the crop. One of the bugs is a pint bottle with a little jag juice in it. This is the worst bug of all. It frequently kills the tops before they get well started and the crop is an entire failure. Then there is the "shiftless bug," the "Oh-that-little-leak-don't-amount-to-much bug," the "guess-I'll-go-up-town bug," the "guess-I'll-go-fishing-today bug," and sometimes the "automobile bug."

I knew a fellow a few years ago who let one of these automobile bugs get into his potato tops, and it certainly stripped the leaves off in a hurry. He made a dicker someway, trading off a $174.98 piano and a set of Engineers books that he said he didn't need, and got an automobile of the vintage of 1897, and it looked the part. One of those little, double-seated "one-lungers" with a tiller in front like a canal boat has behind. The engine was in under the seat, and occasionally when the roads were rough, the fly-wheel would come down on the reach and then this improvised prony brake would stop it. Well, then he would get out, wiggle around under the thing on his back and fix, or unfix, a lot of things, and finally crawl back home late in the evening. He built a horseless horsestable for it out of some old crates that some new machines came in, out behind the boiler room, and day in and day out he would tinker with that old bunch of gasoline cantankerousness. Well one day this bug ate the last of the tops off. While he was out to Mygatts Corners laborously winding up the works, the fireman back home got to day dreaming and forgot to fill the oil cups.

When the bug engineer got back about 5:30 p. m. the boss was mad clear through. "Sam," said he, "how fast can that stink wagon of yours go?" "Oh, if its in fine condition I can reel off 20 miles per, I guess." "Is it in fair condition now?" "You bet yuh! I just put in a new spark plug, out in the country 10 miles, and fixed the carbritter, and I came in in just half an hour." "Well, then Sam," said the boss, "You gather all your earthly possessions you have around here into that cussed contrivance and see if you can go back into the country just as fast."

So you see my Son that you can't hold down a wheelbarrow job with automobile inclinations for the bugs will eat up your tops just as sure as goslings are green, and when you come to dig down there will be nothing but small potatoes.

Now take the buckskin you got at college, or the sheepskin I think you said, anyway, whatever it is that they give you as a receipt for the money I paid out for your education, you take that sample of the engravers art, put it between 2 sheets of paper way down in the bottom of your trunk and don't tell anyone that you've got it—and forget it yourself. Then go out some place, neatly dressed, but not so stylish that they will all think you want to hire out as president of the firm, and pick out a good hustling factory with quite a variety of "junk" in the powerhouse and tell them you want a job, not a situation, or a position, but a job, j-o-b, job, one step below the lowest rung on the 1,000-mile ladder of success, namely the wheelbarrow (the Irishman's locomotive —one drive-wheel and 2 side rods), and wheel in coal and wheel out ashes. There's a lot to learn on the round trip, and the more round trips you make the more you learn. Also, keep your eyes and ears open for things that transpire along the right of way. Railroad men say that everything isn't in the Book of Rules and experience is only gained by experience. Now you go out and get experience, and let me know how you make out.

Affectionately your father,
Sandy MacDougal.

THE CITY OF PITTSBURGH has recently awarded contracts for the equipment for the new Aspinwall Pumping Station which, when completed, will add one hundred million gallons per day to the water supply. The new station is to be erected at Aspinwall near the site of the filtration plant. This station will eventually contain 5 20-gallon pumping engines but only 4 of them will be installed at the present time.

The contract for the entire pumping equipment has been awarded to Allis-Chalmers Company for approximately $300,000. At one end of the station will be placed 2 complete new triple expansion pumping engines with steam cylinders 32, 60 and 94 in. in diameter by 66-in. piston stroke. The water ends are designed to deliver 20 million gallons of water each 24 hr. against a head of 275 ft. when the steam ends receive steam at 160 lb. pressure and 100 deg. F. superheat.

In connection with these units it is interesting to note that the duty guarantees are the highest ever made. The guarantee calls for a duty of 195,000,000 ft.-lb. per 1000 lb. of steam.

At the opposite end of the building 2 new water ends, similar to those of the units already mentioned, will be placed. The steam ends of these units will be the Holly engines now in the Montrose station which are to be dismantled and re-erected on the new water ends. There will remain space in the center of the station for a fifth unit which can be installed when needed.

The new pumping engines will take their supply from a suction line running under the boiler room and parallel to the engines and will discharge into the Montrose rising main which supplies the Troy Hill Reservoir.

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RECIPROCITY

You are a good American citizen, therefore a believer in fair play. You want the other fellow to have what belongs to him, and you don't want to miss anything that's yours.

When you get a copy of Practical Engineer, the whole of it is yours—to use. Did it ever occur to you that the advertisements are just as interesting to the wide-awake engineer as the editorial matter. Both tell you how to operate your plant more conveniently, intelligently and economically.

Did it ever occur to you that fully as much thought and care are devoted to making the ads. tell you something of importance in the quickest and most easily understood way as to the most interesting article that you ever read?

The advertiser is working in your interest as well as his own. His product is devised and marketed to help in power plant operation, and it must do so or he cannot succeed. He helps make the paper that you like to read; and he judges your appreciation of this help by the letters that he receives which mention that paper. It's only fair play to let him know when you write him that you appreciate his help in keeping you posted through your paper. That may seem a little thing, but it's the little things in this world that often count heavily in the end.

Also there is an advantage to you; for a manufacturer will appreciate the fact that you mention Practical Engineer when writing for a catalog or information and will give your request fuller and more prompt attention, knowing that you are an interested, progressive engineer, that you want to make practical progress and by reading an up-to-date paper have proved that you are as keen to take advantage of improvements in machinery and practise as he is to tell you about them.

ABUSING BIG BUSINESS

Why in the name of common sense do the magazines, newspapers and legislative commissions persist in trying to prove that every concern doing a business of unusual size is a fraud and a criminal? There are enough people, goodness knows, who are crowding the line of decency and legality but that is no reason why a big concern or a big man should be abused and misrepresented when it is doing a beneficial business in a helpful way.

All humans make mistakes. We make ours, you makes yours, President Taft makes his. But he has shown himself big enough to take the responsibility for them and his stand is to be respected when he does what he believes right and best, knowing that it will be unpopular. Why should he be abused for it?

Why should a concern like The International Harvester Co. be condemned in an erroneous report when it has improved conditions for users of agricultural machinery, lessened the cost, increased the business, facilitated the obtaining of repairs and improved the machines?

There seems to be a mania for villifying and knocking, and it is time that public opinion be shaped on lines of intelligent discrimination, condemning those whose actions deserve it and acclaiming those who are honestly looking for the greatest good of the greatest number.

CONVENTION OF ENGINEERS, CINCINNATI, SEPT. 11-15

MEETINGS OF THE OHIO STATE ENGINEERS, AND OF THE NATIONAL ASSOCIATION OF STATIONARY ENGINEERS

YES, THE PROGRAM LOOKED attractive even before it started, and everyone knows that Cincinnati is an ideal city for hospitality so that there was every reason to expect a successful convention and a pleasant week. Cincinnati is known as a model city so far as its educational institutions are concerned, hence would have the right atmosphere for educational work; and though aforesaid atmosphere got decidedly moist on several days, yet the spirit of educational activity still remained.

State Sessions

NATURALLY, being in Ohio, the Ohio Engineers had the running of things, and they ran in the state convention first, starting it on Monday morning, at 10 o'clock with an attendance of about 200. Right there was established the fact that it was to be a meeting in which engineers should prove themselves to be the equals of lawyers and statesmen in the matter of public speaking. The address of welcome of Mayor Schwab was met by an equally finished and complete

PRESIDENT E. H. KEARNEY

address of State President Eichhorn, treating on the conservation of the country's resources. While some might not agree with the sentiments expressed, which were rather in the line of using up resources than conserving them, the familiarity of the speaker with his facts and figures and his clearness in expressing them were evidence of sincerity. He spoke in particular of the 100,000,000 hp. of undeveloped energy going to waste over the waterfalls, and in following him, National President Pearse referred also to this power and described some of the high-tension transmission work which is being done in California.

Getting down to business, 44 delegates were reported and seated, committees appointed and reports received, that of the secretary showing 36 associations in good standing with membership of 2365, and the treasurer's showing a balance of $141.57 after expending $374.35. In the report of the President for the year, reference was made to the passage of a Boiler Inspection bill which completes the laws desired by engineers for insuring the safe operation of steam plants in the state.

At many State Association meetings during the summer, the wish has been expressed that the National Association do something to assist in state educational work, and in the passage of license laws, and at this meeting the communications from Kentucky asking the expenditure of not less than $5000 a year for such purposes was endorsed. In the contest for a meeting place for 1912, Lima received the majority of votes, and in the election of officers the following list was chosen: President, John J. Coughlin, of Hamilton; vice-president, Thomas S. Synett, Dayton; secretary, Joseph J. Ahlers of Cincinnati; treasurer, John E. Radigan of Cleveland; conductor, Casper Geise of Delphos; doorkeeper T. J. Kolb of Middletown; recommended for state deputy, T. E. McFadden of Columbus. Officers were installed and a past president's badge was presented to retiring President Eichhorn, and fitting resolutions of thanks were passed to various local organizations.

Tuesday's Start on the Big Convention

THE Monday curtain raiser of the State Convention was a modest affair, but when the Big Show commenced on Tuesday there was nothing small or modest about it. In the exhibit hall was a vast area covered

VICE-PRESIDENT J. F M'GRATH

with interesting and instructive displays of apparatus and in the convention hall was a large and enthusiastic gathering of delegates from all parts of the country. There were the old war horses, such as Jim Beckerleg and John Fehrenbatch, who had served in the harness for 20 years during the entire life of the association, and there were those who had more recently been honored, including Dan Delaney, Bob Ingleson, Royal Tomlinson, Joe Carney, Pat Hogan, and a lot of others, to say nothing of the young colts, such as Kelsey, Fisher, Reynolds, and Pearse. Raven, the secretary bird was there of course, to keep all records straight, and the whole of Pittsburgh's finest "Forse" was available to guard the treasury. Under these circumstances, things were bound to go with an ardor and snap that was gratifying in the highest degree.

Chairman John A. Kerley had the opener on this day as on Monday and welcomed the gathering in behalf of the local association. Then after invocation of the divine blessing, Attorney General Hogan, who apparently is no relation to Pat, welcomed the convention to the State of Ohio, acting in place of Governor Harmon, who was not able to be present. Following came Mayor Schwab, who again extended welcome to the city, and enlarged particularly upon the duty of the association in insuring the protection of life and prop-

erty, the conserving of the fuel supply by economic generation and transmission of power.

President Pearse, in a pleasing address, which was humorous as well as instructive, told of the early accomplishments of Ohio and called attention to the duty of the government in providing protection against loss of life and injury to the people while engaged in ordinary occupations. He showed what had already been done in the passage of a national boiler inspection law for locomotives, in sanitation in the canal zone, and in calling for protection in dangerous occupations; then spoke of the desirability of similar protection in the operation of steam plants, and the logical taking over of this duty by the Federal government. In closing President Pearse quoted from Kipling's poem which starts, "If you can keep your head when all about you are losing theirs and blaming it on you; If you can trust yourself when all men doubt you and make allowance for their doubting too," and closes, "If you can fill each unforgiven minute with 60 seconds distance run; Yours is the earth and all that's in it, and what is more, you'll be a man, my son, and all men count with you, but none too much."

Speaking for the Chamber of Commerce, Walter Draper, its president, extended welcome from the business men, and spoke of the improvements which are under way, including an open ship canal from Toledo, and a uniform and year around depth of water in the Ohio River.

In reply vice-president Kearney spoke of the accomplishment which association and education has made for engineers, developing the position of the man in the power plant from that of isolation to that of a man of broad affairs. He showed what steam and the mechanic arts mean nowadays, and how the engineer must combine professional excellence in his technical knowledge with an application of business rules to his art. Following were Charles H. Wirmel, State Labor Commissioner, and formerly a delegate to national conventions, who spoke of the industries of the state, and finally past national president Reynolds, who closed the speaking with good stories and sallies at the expense of former speakers and finally consigned himself to the exhaust as a "has been." Adjournment was then taken until afternoon.

Getting Down to Business

IN the afternoon session, the first report of the committee on credentials, showed an attendance of 365 delegates and was accepted. National President Pearse, in his report, told of the work of the year, of the increase of state conventions, and of the need of more accurate and prompt work by secretaries throughout the country, stating that no president of any organization in the United States knows so little of the actual membership conditions of his organization as does the president of the stationary engineers.

THE ENGINEERS AT CINCINNATI

In regard to the matter of appropriations for state purposes by the national president, he called attention to the fact that this was impossible as it would be a direct violation of the constitution of the National Association. He asked that in future care should be taken in setting the dates for State Conventions that they do not conflict. Another point was that suggested at the state convention in Illinois that some arrangement be made between the state organizations and state universities, allowing a joint 2 or 3 days' meeting for the benefit of operating engineers, to which the university should invite all manufacturers and employers to send their men. It was recommended that a committee of 3 be appointed to look into the matter of securing the co-operation of state universities and report to the convention. It was suggested also that a national educator be employed to act as a bureau of information and assist local organizations in educational work; and the adoption of a uniform log or daily report for plants was advocated so that authentic engine room data might be gathered for the use of members.

License Committee

IT was stated that the National License Committee seemed to be all that was necessary, and that state license committees appointed by the national association seem to be practically useless; hence, it was recommended that they be discontinued, but that the effort for state license laws be kept up and that engineers work in harmony throughout the state with each other and with employers so that a united stand will be taken for the bills as introduced. The rest of the address was taken up with the discussion of business matters with relation to the National Engineer, the recommendation that the subscription price be made 50c. to be taken out of the per capita tax, and a statement in detail of the difficulties with former publishers.

Vice President's Report

NATIONAL Deputy Kearney praised the state deputies although he found it necessary to utter some words of complaint. He suggested that in the larger states there should be 2 or more deputies with the districts mapped out so that the men could easily reach associations within their jurisdiction, and pointed out that it is necessary not only that a deputy shall have enthusiasm, but that he shall be so situated that he can visit every association in his state at least once each year.

Secretary's Report

SECRETARY Raven, in his report showed the organization of 11 new associations during the year, and that the charters had been returned by 13 associations, giving a total membership at the present time of 20,167. In growth it was shown that Illinois No. 28 of Chicago has gained the largest number of members, except associations which have gained by absorption of other locals. Secretary Raven also called attention to the increase in the enthusiasm of state conventions and to the stronger efforts for state license laws which have been made during the last year.

Resolutions were introduced, providing for the appointment of a paid organizer, with a salary of $2,000 a year and expenses, which was laid on the table; for not less than $5,000 to be expended for license and educational work, resolution for a propagation committee with appropriation for carrying on the work; resolution to reimburse the Michigan state association for money spent in the campaign for state license bill; all of which were referred to the Ways and Means committee.

Life and Accident Department

IN the evening the meeting of this department was held and in report of the chairman, James G. Beckerleg, it was recommended that a form of application be used to embody examination such as is called for in the leading life and casualty companies; that the form of this application shall be submitted to the policy holders for referendum vote, and that a policy be adopted of not readmitting any lapsed policy holder until he shall have paid up all back dues from the time of his suspension to the date when he applies for reinstatement.

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Records of the secretary and treasurer showed 38 claims presented, 32 of which had been paid, and 6 rejected, the rejections being for cause which were supported by the meeting, with the exception of one which was granted. Election of officers resulted in: Trustee, John M. Lynch of Erie, Pa.; secretary-treasurer, J. D. Taylor; chairman of the board of trustees, James G. Beckerleg of Chicago.

Tuesday afternoon was marked also by the session of the Ladies Auxiliary at Sinton Hotel hall, the report showing that 3 auxiliaries have given up charters during the year, 3 have been reinstated, and 6 new ones organized. The auxiliary is at the present time carrying on its list 9 brothers who are drawing pensions and 3 have died during the year. In spite of the work during the year, it was shown that the auxiliary had

been able to pay the necessary pensions without depleting its fund in the slightest.

Another function on Tuesday was an entertainment at Music Hall in which a musical play written by Mrs. William S. Goldenburg, daughter of past president Dan Delaney was staged with over 150 people in the cast.

A Day of Sky Larking

WEDNESDAY was given over, with malice aforethought, to just plain having a good time. Nobody wanted to work, intended to work or did work, but all had a day of pleasure, including a ride on the Ohio River in the steamer Island Queen, a return to Coney Island, a feast on barbecue, burgoo, and all sorts of liquid refreshments; and dancing, athletic sports, including baseball and bowling, races, serious and humorous, and races so-called. The outing which was provided by the Lunkenheimer Co., started at 8:30 in the morning, and ended when you got home. Those on board the boat during the first part of the trip were

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by count 2,360, and enough more went to Coney Island by trolley to bring the total number up to 2500 people. After that voyage to Coney Island everyone was hungry and acted according, and of course, when all were so full that they couldn't possibly move without an acute sense of suffering, running races were started, the first one being the fat men's sprint for 50 yards. Imagine an over-hungry bunch of fat men who had recently fully gratified their appetites, trying to do 50 yards; Albert Fry was the winner and deserved it. Then the sack race of 50 yards was won by William Flynn, with William Baumann second, and a ladies' hobble skirt race in which the skirts didn't all hobble alike, and therefore artificial hobbles had to be substituted, was won by Mrs. Beckerly, with the second prize going to Mrs. Hunter.

Then some real races took place, 50 yards, for the boys, and the girls under 15 raced 50 yards. Then there were other races, including a three legged race, a 100 yards dash, free for all, and a boy's race of 100 yards; and then came the big event, the annual ball game between 9 operating engineers and 9 from the National Exhibitors Association. It was a regular championship game, with the usual blow-up in one inning and the usual uphill fight to recover, but this time in vain, and the game closed with the score 7 to 6 in favor of the exhibitors. The trophy which will be contested for each year was a large silver loving cup.

Wednesday evening was devoted to an exemplification of the work of the Ladies Auxiliary at Sinton Hall and to talking things over, and the talking lasted until well towards morning.

At Work Once More

THURSDAY morning, President Pearse called the convention to order promptly, and the first business was the report of the educational committee. This showed the awarding of 6 prizes, the first, $100 for the association showing the greatest number of points in the educational contest, the second $50, the third $25, and fourth, fifth and sixth prizes of $10 each. Details of the contest which consisted in answering of a series of questions were given, also the statement in regard to the two prizes for individual contest among the members, the first being a gold plated Lippincott Steam Engine Indicator for the best essay on "The Utility of the Steam Engine Indicator as an Essential in the Steam Power Plant," and the second a Horn planimeter, given for the best essay on "The Isolated Steam Plant vs. The Central Power Plant."

The committee expressed as its opinion in consequence of experience in the contest, that too great laxity has been allowed in the past in accepting engineers, that better progress will be made by providing 2 classes of members, one the junior grade, from which after a reasonable period of time promotion can be made into full membership grade. It was announced that the winning associations were Lowell, Mass., and Denver, Colo., tied for first place, Hamilton, Ohio,

third, Omaha, Nebr., fourth, Butte City, Mont., fifth, Newark, N. Y., sixth. In the individual contests, the steam engine indicator was won by E. J. Rose of the Detroit Association and the planimeter by A. W. Miller of Detroit.

The educational committee took up the question of providing systematic courses of instruction, under the control of the national body, and issuing a certificate upon completion of the course, and letters have been received from some associations favoring such a course, but many other associations have expressed themselves as too busy with present work to undertake it. The committee on license reported that it had been unable to collect satisfactory data in regard to the condition of license laws in different states and cities, and therefore recommended the postponement of the publication of such a summary until further information could be gathered.

In regard to the resolutions submitted, that asking for $5,000 for educational and license work was not

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favored nor was the proposal to reduce the per capita tax; also the application of Michigan for money was refused. Memorial service was held at the close of regular business, 149 members having died during the year, and appropriate selections were rendered by a quartet.

In the afternoon the mileage committee reported, and 5 cents a mile was voted to all delegates in attendance. Report was made by the trustees, showing what work had been done by the National Engineer, and stated that the paper needed more money in order to get the services of the best writers for its columns, also that there should be a fund to permit the payment of expenses of the trustees to attend state and local meetings. Various amendments to the constitution were submitted by different local organizations, and all of these were referred to the various committees for routine consideration. Adjournment was taken early on this day and much time was spent by delegates and visitors in the exhibit hall. In the evening an entertainment was given by the familiar artists furnished by the Exhibitors Association, and the remainder of the evening was spent in pleasant chats with representatives of exhibitors.

Finishing Up the Job

FRIDAY, the last day of the convention, was devoted to final activity in various lines. In the first place there was the matter of a convention city for 1912 to be decided upon, and after much orating and cheering, the votes finally stood in favor of Kansas City, Mo. Then in the afternoon came up the question of officers. For vice-president there had been much rivalry, and 4 candidates were in the field, 2 of them seriously, and the others tentatively, but on the first ballot, John F. McGrath of Chicago was elected; the former vice-president, Edward H. Kearney being promoted, according to custom to the president's chair. The well tried veterans, Fred Raven, and S. B. Forse were re-elected as secretary and treasurer, respectively, and for conductor, Fred Ray of Louisville, for doorkeeper, Anthony Deutsch of Cincinnati, and for trustees, Joseph Carney of New York, and George Brownell of Pittsburgh, were the winning candidates.

This completed the work of the convention except for the installation of officers which took place just preceding the annual ball in the ballroom of the Sinton Hotel, Friday evening. At that same time presentations were made of a past president's badge to retiring President Pearse, also a diamond ring to Mr. Pearse, and a handsome diamond and opal ring to Mrs. Delaney, retiring president of the ladies' auxiliary.

The N. E. A.

AT the several meetings of the National Exhibitors Association various propositions were discussed and reports heard, all bearing on how best to conduct the business of the association and make the exhibits

more successful. It appeared that closer cooperation was necessary between the exhibitors and engineers, and, perhaps earlier completion of arrangements for the exhibit. It was agreed that, in future 50 per cent of the gross receipts from exhibitors shall be spent for entertainment features at the convention, and that this shall amount to not less than $2,000 each year.

Election

THREE tickets were placed in the field, one by the regular nominating committee, another by an independent committee, and a third by the association's official joker. Election was held on Thursday morning, and the election resulted in the choice of H. H. Ashton of Ashton Valve Co., Boston, as president; M. B. Skinner, of Jas. McCrea & Co., Chicago, as vice-president; Homer Whelpley of Strong, Carlisle & Hammond Co., Cleveland, as secretary, re-elected; William P. Johnson of Underfeed Stoker Co. of America, Buffalo, as treasurer, and as members of the executive committee, Louis B. Mann, of The Fairbanks Co., New York, H. A. Pastre of The Elliott Co., Pittsburgh, J. W. Peterson of The Richardson-Phenix Co., New York, Harry Raymond of A. W. Chesterton Co., Boston, and F. E. Sly of The Allis-Chalmers Co., Milwaukee. At a meeting of the exhibitors held on Friday evening, at the convention hall a handsome watch and chain were presented to retiring president Wm. G. Purcell, Home Rubber Co., in token of the appreciation which the members of the association felt of the work that he had done. The presentation speech was made by F. R. Low.

The Exhibit

IN every way the exhibit was the most satisfactory ever held at a National Convention. The hall was sufficiently large so that all exhibits were on the same floor and sufficient space was provided to give every exhibitor ample room. The hangings and decorations were artistic and attractive, and arrangements of exhibits by the individual exhibitors were pleasing and at the same time so made that in every booth there was much that could be seen and studied to advantage.

The exhibit was so large and so varied that it is impossible to give any adequate description of it in the space which could be devoted to the subject. Those who were fortunate enough to be able to attend and study the exhibits will remember and carry to others the message which they learned. For the rest the list of those exhibiting and the representatives present at the convention are impressive as showing the importance and completeness of the display.

The F. W. Niebling Co., of Cincinnati, represented by F. W. Niebling; The Under-Feed Stoker Co. of America, Chicago, represented by Wm. T. Johnson, W. F. Trotter, and W. R. Faben; the Wm. Powell Co., Cincinnati, represented by Charles E. McFarlan, vice-president, Charles Cullen, M. F. Brenner, W. J. Leonard, J. H. Ruckel, Jimmy Coombe, W. H. Meenach and Wm. H. Wonfor; The Crandall Packing Co., Palmyra, N. Y., represented by J. M. Chapman, manager of the Cleveland office, J. C. Stout, and A. N. Beadle; The Standard Oil Co., New York, represented by Geo. A. Burt of Cleveland; Ridgway Dynamo & Engine Co., of Ridgway, Pa., represented by R. C. Eccleston, assistant sales manager, and P. G. Rimmer, manager of the Wilkes Barre office; Mason Regulator Co., of Boston, represented by Frank Morrison, and W. J. Kennedy; the Garlock Packing Co., of Palmyra, N. Y., represented by E. P. Watrous, T. C. Green, E. L. Landreth, C. V. Whitehouse, C. McDole; The V. D. Anderson Co., of Cleveland, represented by Joseph H. Meyer, R. E. Bronson, Bruce Lounsbury, and Henry J. Meyer; the D. T. Williams Valve Co., of Cincinnati, represented by D. T. Williams, Harry Ernst, in charge of the exhibit, Harry Sharp and James Fields; The Bird Archer Co., of New York, represented by Arthur J. Arwine, and J. C. McGurnes; The S. C. Regulator Co., of Fostoria, O., represented by N. G. Copley, G. F. Duemler and C. A. Hale; The Moore Oil Co., of Cincinnati, represented by John Edwards, Frank A. Meyer, S. G. Ware, C. J. Simpson, A. W. H. Jameison, Wm. Gribbelle and Charles Rice; The W. B. McVicker Co., New York, represented by John J. McDonald, manager of the New York office; The McDonough Automatic Regulator Co., represented by A. J. McDonough; the Hooven-Owens-Rentschler Co., Hamilton, O., represented by Oscar D. Dillman, E. B. Amole, R. C. Holman, and W. B. Mayo; The New Era Manufacturing Company, represented by H. P. White, and C. N. White; The Federal Metallic Packing Co., Boston, represented by A. A. Gill, and C. W. Wheaton; The Burr Oak Belting Co., represented by D. T. Pierson, W. L. Hallpike, Charles Wellman, and E. D. Rowe; Otis Elevator Co., New York, represented by J. J. Cox, J. Westerlund, and G. E. Cassidy; Armstrong Mfg. Co., Springfield, O., represented by W. C. Armstrong; the National Engineer, Chicago, represented by Robert W. Larkin, L. L. Rice, John W. Lane, and Wm. T. Mugg; The Westinghouse Companies, Pittsburgh, represented by M. H. Burchard of Chicago, S. H. Mills of St. Louis, O. H. Miller of New York, and C. S. Carricks of Pittsburgh for the Air-Brake Co., and P. F. Hegerty for the Machine Co.; A Leschen & Sons Rope Co., St. Louis, represented by C. R. Dean, E. J. Sorber, and W. C. Henning; The Franklin Oil Filter Co., St. Louis, represented by J. B. Beall, manager; International Correspondence Schools, Scranton, represented by J. D. Jones, W. M. Brainard, M. R. Dallon, and W. S. Gould; Triumph Ice Machine Co., Cincinnati, represented by C. M. Gilbert; Triumph Elec. Co., Cincinnati, represented by Walter Leile, and Walter Underwood; Revere Rubber Co., Boston, represented by J. W. Dudgeon and A. C. Kingston; Hills-McCanna Co., Chicago, represented by Robt. E. Hills, and Thos. A. Delaney; Peerless Rubber Mfg. Co., New York, represented by Stephen Roberts, advertising manager, C. F. Heitzmann, R. F. Gearhart, and W. C. Briggs; McLeod & Henry Co., Troy, N. Y., represented by John H. Foote, Chas. N. Morgan and A. W. Pettie; The Williams Gauge Co., Pittsburgh, represented by C. E. Wolff, Jr.; Jos. Dixon Crucible Co., Jersey City, N. J., represented by L. W. Brooks, and F. R. Brandon; Practical Engineer, Chicago, represented by E. R. Shaw, John A. Kershaw, C. B. Leech, Charles S. Clarke, A. Vlerebome, and Arthur L. Rice; International Acheson Graphite Co., Niagara Falls, represented by M. A. Smith, and W. M. Collier; A. W. Cadman Mfg. Co., Pittsburgh, represented by R. W. Cadman, and A. M. Cadman; Quaker City Rubber Co., Philadelphia, represented by A. D. Thompson, and H. Rittenhouse; The Cling-Surface Co., Buffalo, represented by Wm. D. Young, secretary, and W. C. Jones; The Gutta Percha and Rubber Mfg. Co., New York, represented by S. M. Hildreth; the Marion Machine Foundry & Supply Co., Marion, Ind., represented by A. J. Calpha, and D. B. Fox; the H. W. Johns-Manville Co., New York, represented by B. C. McClure of New York, H. W. McKinley, E. E. Skinner, G. R. Lewis and H. L. Steiner; The Toledo Pipe Threading

Machine Co., Toledo, O., represented by W. C. Longnecker, S. S. Thornberry, and R. R. Irwin; The Diamond Power Specialty Co., Detroit, represented by John Harley; The Hawkeye-Boiler Compound Co., Chicago, represented by H. E. Tibbles, W. O. Tibbles, G. A. Shaw, I. E. Cook, B. F. Dodge, and R. E. Everett; The Geo. W. Lord Co., Philadelphia, represented by Roy C. Downes, vice-president, Wm. Hulvershorn, H. L. Gaskill of California; The Ohio Grease Lubricant Co., Loudonville, O., represented by Wm. Hulvershorn, Geo. A. Mull, and J. C. Ross; The Ashton Valve Co., Boston, represented by Harry H. Ashton and Columbus Dill, and also in Cincinnati by Dorman-Roehrer Co.; The Anchor Packing Co. Philadelphia, represented by Robert W. Becker; The F. A. Nusbaum Co., represented by F. A. Nusbaum; Greene-Tweed & Co., New York, represented by F. E. Ransley, B. M. Bulkley, and G. A. Hawkins; The Lagonda Mfg. Co., Springfield, O., represented by Morris Sellers, sales manager, J. P. Maloy, James H. Johnston, L. F. Trumbull, Wm. J. Patterson, Elmer Cincinnati, represented by H. L. Ansted, vice-president, and manager, B. Richards, F. Gemmer, James Klimper, and Barton Rogers; The Hawkes Boiler Co., of Chicago, represented by C. W. Hawkes, president, and Harry E. Wallace; The Smooth-On Mfg. Co., of Newark, N. J., represented by Hill & Griffith, agents, and by Charles E. Googins of the Smooth-On Co.; The Lunkenheimer Co., Cincinnati, represented by Sam L. Moyer, D. C. Jones, Wm. Muench, Lane Thompson, Herbert R. Wunder, Joseph Hewitson, Frank Schneider, Wm. Schmidt, Harry Burgdorf, Jerome Aull, George Elliott, B. J. Hausfeld, Frank Bowes and Elmer Ritter; The American Radiator Co., of Detroit, represented by F. C. Reader, and R. J. Moore; The Richardson-Phenix Co., of New York, represented by J. William Peterson, E. H. Lostetter, and G. E. Peterson; The Peterson Engineering Co., New York, represented by G. E. Peterson; The Mechanical Rubber Co., of Cleveland, represented by H. J. Kappler, manager of the packing department, and A. C. Conway; Evans-Elmirall & Co., of New York;

GROUP OF CINCINNATI EXHIBITORS

Houer, and C. A. Conn; The Keystone Lubricating Co., Philadelphia, represented by Charles A. Hopper, L. L. Lacey, M. B. Urquhart, and T. W. Armstrong; The Trill Indicator Co., Corry, Pa., represented by W. L. Trill, president, and L. T. McElroy; The American Ship Windlass Co., Providence, represented by J. F. Mallory; The Safety Equipment Manufacturing Co., Chicago, represented by F. E. Gould; The Gwinn Gas Burner & Engineering Co., represented by J. M. Wykel; The Arctic Ice Machine Co., Canton, O., represented by S. J. Whelan; S. F. Bowser & Co., Ft. Wayne, Ind., represented by A. D. Wyckoff, W. L. Morris, W. A. Armstrong, C. B. Evans, and W. E. Jenkinson; The Bishop-Babcock-Becker Co., Cleveland, represented by H. P. Mishler, of Cleveland; The Riverside Metal Refining Co., Cincinnati, represented by W. F. Parry; The F. B. Lawrence Electric Co., Cincinnati, represented by Geo. Knop; The Crocker-Wheeler Co., Ampere, N. J., represented by C. S. McGill; The Terry Steam Turbine Co., Hartford, Ct., represented by L. G. Finlay; L. Steigert Co., Cincinnati, represented by Geo. Steigert; The Fisher Governor Co., Marshaltown, Ia., represented by Geo. H. Beebe, and R. B. Reasoner; The Vanda Co., New York, represented by Hudson Dickerman, and Frank Kersher; The Black Diamond Manufacturing Co., Cincinnati, represented by J. R. Flannagan, and J. L. Sullivan; The Atlas Rubber & Belting Co., of The Hamler-Eddy Smoke Recorder Co., of Chicago, represented by E. J. Hamler, and Ray L. Eddy; The Fairbanks Co., New York, represented by L. B. Mann; The A. W. Chesterton Co., Boston, represented by H. L. Raymond; The Ohio Blower Co., Cleveland, represented by H. H. Lind, and D. K. Swartwout, Jr.; The Mining & Engineering World, Chicago, represented by J. W. Holman, Lyman Siseley, and Everett Rogers; Jas. McCrea & Co., Chicago, represented by M. B. Skinner, and H. M. Melville; The McCord Mfg. Co., Detroit, represented by E. G. Hunter and W. M. Chamberlin; Warren Webster & Co., Camden, N. J., represented by W. C. Green, H. J. Krampe, C. M. Heath, N. Stark, and F. W. Wren; G. L. Simonds & Co., Chicago, represented by G. L. Simonds, W. C. Green, and H. J. Krampe, and representing the Wm. B. Pierce Co., of Buffalo, and Vulcan Soot Cleaner Co.; Henry R. Worthington, Geo. S. Blake & Co., and the Laidlaw-Dunn Gordon Co., New York, were represented by Geo. W. Galbraith, sales manager, W. I. Monaghan, H. J. Myers, W. C. Dunn, and H. B. Placke; R. G. Von Kokeritz Co., New York, were represented by N. P. Hill, J. A. Carson, and W. G. Werbeck; Crane Company, Chicago, was represented by Edmund Burke of Chicago, and the Cincinnati branch, the Crane-Hawley Co., by John J. Springer, G. T. Brooke, Clifford Blaesi, and Harry Stegemeier; Osborne High Pressure Joint and Valve Co., Chicago,

represented by W. L. Osborne and C. M. Schneider; The Albany Lubricating Co., New York, represented by G. E. Tandberg and Geo. A. Wellington; The Desmond-Stephan Co., Urbana, O., represented by H. H. Dovell; The Elliott Co., and the Liberty Mfg. Co., Pittsburg, represented by H. A. Pastre, H. E. Stone, Frank Walmsley, and D. S. Tucker; W. H. Simmons & Co., of Cincinnati, represented by William Johns, and Fred Phillips; Automatic Steam Trap and Specialty Co., Cleveland, represented by C. L. Strong; The Scandanavian Belting Co., and the New York Oilless Bearing Co., Cincinnati, represented by Geo. W. Cushing; The Wickes Boiler Co., Saginaw, Mich., represented by James Milne, C. F. Wilson of Chicago, and by J. R. Mason of Pittsburgh; The Eagle White Lead Co., Cincinnati, represented by John Cripps, P. M. Mainguy, W. A. Woodmansee, A. B. Bellville, and F. J. Baringer; The France Packing Co., Tacony, Pa., represented by J. F. Boreland; The Arrow Boiler Compound Co., St. Louis, represented by E. M. Swindler; The Ferguson Publishing Co., New York, represented by A. D. Ferguson, president, and A. C. Oliver; Henry Vogt Machine Co., Louisville, represented by J. G. Eury; The American Steam Gauge & Valve Mfg. Co., Boston, represented by Chas. C. Kilander and Arthur W. Hobbs; The Universal Lubricator Co., Philadelphia, represented by H. G. Merrick, Geo. Hingston, and Charles Hesst, and also by the W. G. Johnston Co., of Cincinnati; Philadelphia Grease Mfg. Co., Philadelphia, represented by T. Addison Collins, president, and Horace A. Smith; Knopf & Johnson, Richmond, Ind., managed by A. S. Cain; Eagle Oil & Supply Co., and the Perolin Co., of America, New York, represented by C. M. Viley; C. E. Squires Co., Cleveland, represented by C. E. Squires and C. Spero; The Lytton Manufacturing Corporation, New York, represented by D. J. Lewis, Jr., and J. W. Lytton; The Kent Lubricating Co., Waukesha, Wis., represented by L. H. West; Geo. M. Newhall Engineering Co., Philadelphia, represented by James A. Coutts; The Evans Oil Works, represented by W. A. Evans, president, Albert Lawrence, vice-president, C. P. Wagner, and J. G. Clemens; The Creaghead Engineering Co., Cincinnati, represented by R. R. Deland, and Sinclair Randall; Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y., represented by T. J. Menten of New York; The Murdock Mfg. & Supply Co., of Cincinnati, representing Direct Separator Co., James Beggs & Co., the Webco Union Co., Scully Steel & Iron Co., represented by W. E. Perkins; The New York and New Jersey Lubricant Co., New York, represented by J. D. Kelvie; The American Fabric Belting Co., and The American Metal Hose Co., New York, represented by L. A. Ford; F. & S. Koenigkramer of Cincinnati represented by Mr. Koenigkramer; Chapman Valve & Mfg. Co., Indian Orchard, Mass., represented by Charles Webber; The National Tube Co., Pittsburgh, represented by L. F. Hamilton, C. E. Kennish, and B. F. Bart; The Hartford Steam Boiler Inspection & Insurance Co., Hartford, Conn.; The Pennsylvania Oil & Supply Co., Oil City, Pa., represented by F. R. Corbett; Lake Erie Boiler Compound Co., Buffalo, represented by J. R. Pratt; John A. Roebling's Sons Co., Trenton, N. J., represented by W. W. Affleck, J. W. Troescher of New York, and J. H. Wilson of Chicago; The Builders Iron Foundry, Providence, represented by N. L. Sammis and W. D. Hess of Chicago; The Mineral Products Co., Detroit, represented by C. E. Callender, B. F. Paddock, and E. F. Drake; The American Steam Pump Co., Battle Creek, Mich., represented by T. E. Brady and A. C. Benton; The Hill Pump Valve Co., represented by W. T. Birch; The Philip-Carey Co., represented by R. E. Kramig Co., as agents, and having as representatives, R. E. Kramig, J. G. Gartner, and Cliff Reel; Jenkins Bros., New York, represented by Frank Martin, H. B. McClelland, H. C. McLaughlin, and Mr. Scott of the Atlanta office; Cancos Mfg. Co., Philadelphia, represented by Worthlin-Scallan Co., and the representative for both companies being S. S. Pritchard; Pittsburg Gauge & Supply Co., Pittsburg, represented by Howard Noel; The Huhn Metallic Packing Co., New York, represented by A. A. Judd, F. J. Davis, and J. J. Schwende; The New York Belting & Packing Co., New York, represented by Charles A. Wilhoft, manager, F. E. Friedlander, and A. C. Reed; United States Graphite Co., Saginaw, Mich., represented by H. Woodruff, Fred Lee, W. J. Teeple, Geo. Lenox and P. F. Dawson; The Allis-Chalmers Co., Milwaukee, represented by M. C. Miller, sales manager, R. D. Tomlinson, F. S. Sly, Ed. C. Colwell, and R. C. Stueve, and Mr. Badoux; Clement Restein Co., Philadelphia, represented by E. L. Parker, and L. W. O'Brian; The Dearborn Drug & Chemical Works, Chicago, represented by Dan Delaney, P. H. Hogan, W. O. Clark, D. A. Amsbury, Frank Eardley, E. H. Ruhlmann, A. S. Cooke, and Paul T. Payne; The W. R. C. Smith Publishing Co., Atlanta, represented by H. H. Kelley; The Home Rubber Co., Trenton, N. J., represented by Charles F. Green, Wm. D. Purcell, and A. R. Foley; Ashcroft Mfg. Co., The Consolidated Safety Valve Co., The Hancock Inspirator Co., and the Hayden and Derby Mfg. Co., New York, all represented by L. F. Brigham, F. J. Corbett, and C. M. Smith; The Hill Publishing Co., New York, represented by F. R. Low, J. W. Armour, H. R. Annes, A. P. Shaw, and V. W. Johnston; Strong, Carlisle & Hammond Co., Cleveland, represented by F. S. Palmer, A. B. Pinney, Homer Whelpley, and F. E. Farland, and its representatives in Cincinnati, the Queen City Supply Co., by Geo. A. Edmondson.

MINNESOTA STATE CONVENTION

AT the second convention of the state organization, the Minnesota engineers set a pace for attendance and interest which will be hard for adjoining states to follow. To keep busy men like engineers interested in convention matters for 4 days is no small task, but such is the record of those in charge of the convention at St. Paul. Headquarters for the State Association of Engineers and the Central State Exhibitors' Association were made in the Merchants Hotel, where almost the entire second floor was given over to the associations for holding meetings, exhibit halls, etc.

During the opening meeting, held about noon on Aug. 23, addresses of welcome were extended by Herbert P. Keller, mayor of St. Paul, and James C. Haynes, mayor of Minneapolis. These were responded to in behalf of the engineers and exhibitors by National Secretary Fred Raven.

The afternoon session was taken up with reports of committees and other matters of business routine. President H. M. Germain reserved his address until the evening meeting, when he told of the progress of the association and its financial condition, which had advanced from $10 last year to $100 at the opening of the convention.

The principal lecture of the evening was given by Jos. L. Barnard, on Incandescent Lamps. Beginning

with a historical account of the development from the carbon to the Gem, tantalum and tungsten or Mazda lamps, he spoke of the peculiarities of each and compared their efficiencies.

Thursday morning a lecture on Ventilation was given by H. E. Gerrish, of Minneapolis, who used a large number of lantern slides to illustrate his talk, which was practical in every respect, showing the need of good ventilation, how it may be obtained and the power required to operate air-moving machinery.

As the guests of the St. Paul Commercial Club those attending the convention were taken on an excursion down the Mississippi River Thursday afternoon on the steamer Purchase. The weather of the afternoon was delightful, and those who took the trip had a very enjoyable time. A theater party arranged by the entertainment committee was the event of the evening, and proved a great pleasure to those who attended.

Following a short business session Friday morning, W. A. Converse, of the Dearborn Drug & Chemical Works, gave a lecture and demonstration on the causes of trouble in steam boilers attributable to feed water. He spoke of the source of impurities of feed waters, described their qualities when existing alone and in the presence of other impurities and what their effect on the operation of boilers may be. He also demonstrated how an engineer can determine the presence and amount of detrimental impurities.

The afternoon and evening were given over to the exhibitors, who entertained the delegates and engineers by demonstrations in the exhibit hall during the afternoon, and in the evening the Central State Exhibitors' Association acted as host to the engineers, delegates and ladies at an informal spread and smoker. F. W. Raven was toastmaster and called upon the eminent men at the convention for speeches until a late hour. During the evening a silver loving cup was presented to Wm. P. Lyons, retiring president of the C. S. E. A., and Secretary E. P. Gould received a gold watch as token of esteem from brother exhibitors. Music was furnished by a male quartet selected from among the exhibitors.

The Saturday morning business session was largely a discussion of the attitude the association should take in regard to the state license law which was before the legislature during the past session. The inadequacy of the present law was recognized by all delegates and the new law as drafted seemed to meet the approval of the association, but failed to become a law, owing to lack of support and omission of a clause stating what should be done with the present licenses. The matter was left in the hands of a license law committee, which will report at the next annual meeting of the Association before presenting the bill to the next session of the legislature.

C. F. Wilson gave a lecture on Steam Boilers, going into the history of their development, stating in a brief way the necessary points for efficient steam generation and citing a few of the mechanical details which go to make up the most accessible and durable boilers.

An address on Engineers' License Laws was given by J. A. A. Burnquist in the afternoon. Mr. Burnquist spoke of the need of a good law in Minnesota and the principal features of the law which has been recommended by the license law committee of the association.

Winona was chosen as the place of meeting next year, and the officers elected are as follows: F. J. Striffe, president; J. B. Crane, vice-president; J. A. Johnson, treasurer; Jas. McGary, secretary; P. B. Wells, conductor; Jas. McIver, doorkeeper; Jos. Ohrbeck, trustee; J. B. Roberts, trustee short term; T. S. F. Hayes, deputy.

Exhibitors

THE St. Paul convention is the second in Minnesota at which the Central States Exhibitors' Association has had charge of the mechanical exhibition, and marks the close of the first year for this organization. The work has been most decidedly satisfactory and the association has met with the co-operation of all the associations of engineers in the Central States. A notable increase in the number of exhibits at the different conventions, a uniformity in the manner of decorations and a more congenial feeling towards brother exhibitors have prevailed throughout the entire year.

At the business meeting, which was held on Friday, a report of the year was read, which showed the immense amount of work that had been done by the officers of the association, and also the amount of money which was turned over to the different states, which has bound the Engineers and Exhibitors' Associations firmly together.

Officers for the coming year were elected as follows: F. E. Ransley, president; W. L. Osborne, secretary-treasurer; executive committee, R. E. Hills, chairman, W. A. Converse, Wm. P. Lyons, E. P. Gould, John B. Freye, H. E. Tibbles, T. W. Armstrong; vice-presidents, M. D. Neely, Illinois; Charles Reedy, Iowa; Albert Ahren, Indiana; Charles Cullen, Kentucky; James Milne, Michigan; F. Camitch, Minnesota; Fred Brunner, Wisconsin; Fred Groom, Missouri.

The firms occupying booths and their representatives are as follows: Dearborn Drug & Chemical Works, W. A. Converse, E. P. Ward, F. R. Roddy and T. S. F. Hayes; Western Electric Equipment Co., of St. Paul, H. N. Snyder and J. M. Hannaford, Jr.; H. W. Johns-Manville Co., E. A. Guenther; The Wm. Powell Co., Charles Cullen; R. B. Whitacre & Co., St. Paul, E. M. Whitacre and A. C. Nelson; Crandall Packing Co., Fred Brunner; Hawk-eye Boiler Compound Co., H. E. Tibbles, W. O. Tibbles and J. G. Crozier; Bryan-Marsh Co., Jos. L. Barnard; Viscosity Oil Co., George Swanson; The Keasbey & Mattison Co., John Flack; Quaker City Rubber Co., J. B. Freye; The Western Supply Co., St. Paul, F. J. Camitch and J. O. Francis; U. S. Graphite Co., C. H. Schenck; Under-Feed Stoker Co., of America, Wm. Brodie and S. A. Williamson; American Steam Gauge & Valve Mfg. Co., W. R. Ladewig; Osborne High Pressure Joint & Valve Co., W. L. Osborne; A. H. Beach, St. Paul, A H. Beach; Garlock Packing Co., Rudolph G. Starkwetter; S. D. Rollins & Co., S. D. Rollins; Lyons Boiler Works, Wm. P. Lyons; Jenkins Brothers, J. H. Williams and C. J. Jackson; Geo. M. Kenyon, Walter F. Minty; Mexico Brick & Fire Clay Co., F. R. Minton; Electric Machinery Co., Chas. W. Arrick; Keystone Lubricating Co., A. S. Bennett, F. A. Morris and T. W. Armstrong; Benj. F. Kelley & Son, W. S. Hoffman; Fort Wayne Electric Works, M. B. Beatie; Northwestern Radiator Co., John Roberts; Wickes Brothers, James Milne and C. F. Wilson; Valley Iron Works, Thomas Cameron; Superior Iron Works; The Lunkenheimer Co., E. P. Gould and Chas. C. Madison; Schaeffer & Budenberg Co., W. H. Shenton; Robinson, Cary & Sands Co., Charles Peters and W. C. Buck; Fairbanks, Morse & Co., A. E. Garland; Wm. McMillan & Co., Wm. McMillan; Crane & Ordway Co., H. T. Nyberg and A. Reagan; St. Paul Machine Works, Geo. B. Kahlert; Kunz Oil Co., Jas. F. Kunz and E. M. Kunz; Wm. Bros Boiler & Mfg. Co., Wm. Bros and E. W. Ashenden; W. S. Nott, L. J. Van Dewall; Practical Engineer, R. E. Turner; Greene, Tweed & Co., F. E. Ransley and G. A. Hawkins.

FIRST MEETING OF THE INSTITUTE OF OPERATING ENGINEERS IN NATIONAL CONVENTION

ON June 22 the Institute of Operating Engineers was incorporated as a New York state corporation and the first annual convention was held in the city of New York, Sept. 1-3. The meeting was not large in numbers but those present were enthusiastic in regard to the work which has been accomplished and which is in view for the near future, and the papers presented were of a class to do credit to an organization which has been in existence for a long time.

The opening address was made by Prof. Wm. D. Ennis, who spoke briefly of the work that had been done and called upon Ex-congressman Wm. S. Bennet to welcome visiting members to the city. Meetings were held in one of the assembly rooms in the Engineering Societies Building, 29 W. 39th St., where the headquarters of the Institute are located. An attendance of some 50 delegates and members listened to the opening addresses and took part in the discussion of papers. Ex-congressman Bennet complimented the Institute on the work which it was undertaking and the spirit expressed in its proposed constitution of enabling every man who started in the operating engineering field to rise to his highest possibilities in his chosen vocation and the method outlined of showing him the easiest path of progress.

Following Mr. Bennet, J. C. Jurgensen, who is in reality the founder and planner of the Institute, told a little of the history, how the idea of the Institute was developed and the work which he did in providing engineering instruction for his engine room force which led up to the formulation of the plan of the Institute. He told also of the excellent results which had been secured in this preliminary pioneer work.

Following this there were short speeches by F. R. Low, on the Operating Engineer's Future, showing the difference between the operating conditions of the past, which have required only a knowledge of how to run rather simple machinery, and the needs of the future, which require an engineer trained not only in the proper operation of machinery, but the proper relations and methods of handling to secure the highest economical results.

D. B. Heilman, of Pennsylvania, chairman of District No. 3, told of the responsibilities of the engineer to the general public in keeping our every-day life in motion and spoke of the importance which the work of the Institute will have in securing for the engineer recognition of his rightful importance to the community and of his true place in the professions.

A. R. Maujer, speaking in place of A. C. Dougall, who was not able to be present, spoke briefly on the relations between employer and engineer and emphasized the fact that the engineer should take advantage of his opportunities to prove his own importance and the value that he can be to his employer.

The plans of the Chicago branch were described by J. P. Fleming, chairman of the branch, including the course of lectures on steam engineering subjects to be delivered during the fall and winter and the arrangements in progress to provide special instruction in operating engineering for members of the Institute in courses in the different evening schools of the city.

Committees appointed were, for constitution and by-laws, Arthur L. Rice, Chicago; W. G. Freer, New York; J. A. Pratt, Philadelphia; V. L. Rupp, Philadelphia; and Willis Lawrence, New York. Nominating committee: R. D. Tomlinson, Milwaukee; J. L. MacVicar, Boston; H. M. Elder, Richmond, Va., and Fred R. Low, New York. Finance committee: D. B. Heilman, Reading, Pa.; J. C. Stewart, New York; R. D. Tomlinson, Milwaukee; J. P. Fleming, Chicago, and H. W. Geare, New York.

Adjournment was then taken until the afternoon session when 3 technical papers were presented, the first on Temperature Changes and Heat Transmission, by V. L. Rupp, chief engineer, and was an important discussion of the subject of boiler economy.

Boiler Room Analysis, a paper by J. P. Fleming, gave a method of making a proximate analysis of coal in the engine room without employing expensive apparatus. Large samples were to be used so as to make the errors of weighing small and actual operating conditions were to be maintained rather than laboratory conditions. The third paper, on Cooling Towers Versus Steam Pumps, treated rather of the changes which may be made to give best economy by the use of appropriate apparatus, the conditions in the plant having quite as much to do with the appropriateness of cooling towers as any relative advantages of the two kinds of apparatus. The paper will be given at some length in a later issue.

In the evening Prof. W. D. Ennis, of Brooklyn Polytechnic Institute and chairman of the committee on education, spoke on The Professional Spirit, giving an address which is well worthy reporting in full, but which we are unable to present at this time, and J. A. Pratt showed by lantern slides the work that is being done in the Williamson Trade School in teaching operating engineering, a course which covers practically the apprenticeship requirements of the Institute of Operating Engineers.

Saturday morning was devoted to a business session, the ballots for members in the different grades being counted as cast by members, and all members listed on the ballots were declared elected to the grades as scheduled. The treasurer's report showed total receipts up to Sept. 1, $2284.41 and expenditures $2156.65. The expenses for the past year have included the fitting up of an office, the getting out of pamphlet prospectuses showing the aims and organization of the Institute, and heavy postage expense, so that expenses have been higher in proportion than they will be in future years.

The committee on education presented its report showing the requirements for various grades of membership and the subjects which must be covered in order to meet these requirements. This report has been printed and can be obtained by applying to the secretary of the Institute, at 29 W. 39th Street, New York City. A similar list of requirements has been prepared by the committee on apprenticeship grade and can also be obtained at the above address.

Statistics have not been secured to any great extent from the members. It is hoped, however, that as branches are organized local committees will aid in the securing of data on the size and condition of plants, cost of operation, wages, hours of work, etc., and thus enable some idea to be formed of the kind of

plants in which the different members in different grades are working and the wages which on the average are paid in such plants. The committee has during the last year placed 17 men in high grade positions, one being called to a plant in New Hampshire where he is now drawing $240 a month.

The finance committee reported the books of the treasurer correct and the constitution committee reported a number of changes in the constitution as proposed, in the direction of simplifying the operation of the Institute for the time being and putting in the by-laws and rules all matter which does not involve fundamental laws and principles of organization. The changes of greatest importance were the substitution of 12 years' practical experience as the requirement for the grade of master operating engineer in place of 14 years, with provision to allow 4 years' course in a recognized technical school or college as equivalent of 2 years' practical experience; the election of members by letter ballot of the board of control, and the changing of initiation fee so that it is now, for master operating engineers and operating engineers, $10; for journeyman operators, $5; for senior apprentices $3, for junior apprentices $2. Quarterly dues of operators were also reduced from $2.50 to $1.50 and of senior apprentices from $1.50 to $1. It is also understood that the dues, as stated in the constitution, will take care of all dues of both national and branch organizations, the division between the 2 organizations being arranged by the board of control as may seem to meet the needs of the organization from time to time.

Report of the nominating committee was for president, J. C. Jurgensen; vice president for one year, Willis Lawrence; for 2 years, W. D. Ennis; for 3 years, J. G. Ould; secretary, H. E. Collins; treasurer, W. P. F. Hill.

This is practically a re-election of the officers of the temporary organization who have done a large amount of work already in placing the organization in its present healthy condition.

At the afternoon meeting papers were read by R. D. Tomlinson, on Engine Lubrication; by F. L. Johnson on Reduction of Lubrication Costs in Smelter Power Plants, a paper prepared by Geo. L. Fales, of the Tennessee Copper Co., Copperhill, Tenn., by H. E. Collins, a paper prepared by Darrow Sage on Removing Emulsified Oil from Condensed Water.

Diversions from Convention

SATURDAY evening was devoted to a visit to the 59th Street station of the Interborough Rapid Transit Co., which is one of those in charge of Mr. Lawrence, one of the vice-presidents of the Institute. This station was the first in which the horizontal vertical compound engines were used and also the first in which a large installation of exhaust steam turbines was operated. Sunday was left open for trips about the city by out-of-town visitors and they were hospitably cared for by those familiar with the city.

The notable thing in regard to the meeting was the value of the papers presented for a first convention, the lively and extended discussion and the interest shown from all points in the country where branches are organized or in process of organization. Such favorable conditions promise well for an important and prosperous future.

"CHARACTER IS the foundation for all honest and good work."

DEATH OF EDWARD McCARTHY

IT is with deep regret that we announce the death of Edward McCarthy, western sales manager for the Geo. W. Lord Company. His death occurred suddenly, Aug. 18, 1911, in Johnstown, Pa., from an attack of acute indigestion.

Mr. McCarthy has been connected with the Lord Company for 15 years, and was so well and favorably known among engineers, because of his manly qualities

EDWARD M'CARTHY

and square dealing, that his death will cause general sorrow in many hearts.

He was born in Philadelphia in 1843. He enlisted during the Civil War, and served with distinction for 3 years as a member of Co. D, 19th Regiment, Pennsylvania Cavalry Volunteers. He was a member of Santa Marie Council No. 263, K. of C.

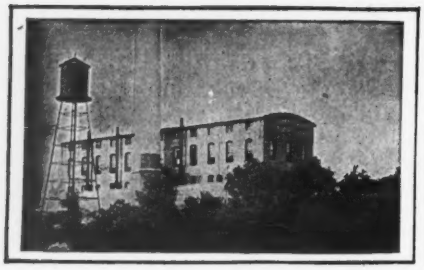
He is survived by a widow and several grown-up sons and daughters.

NEWS NOTES

LARGE MANUFACTURERS are coming to realize more and more the value of binding their organizations closely together by giving attention to the social enjoyment of employees. Following out this line the Goulds Mfg. Co., of Seneca Falls, N. Y., on August 23, held its first picnic at Cayuga Lake Park, the affair being signalized by motor boat races, field and track athletic events, both serious and humorous, and social games. It was a most successful affair and the company is to be congratulated on its new departure.

THE BURY COMPRESSOR Co., Erie, Pa., has just built a 22 by 13 by 20 in. class C C 4 B S O motor-driven air compressor with synchronous motor mounted on shaft for the Pennsylvania General Electric Co., which is installed in its new plant at Erie, Pa., equipped with straight shot mechanically operated Corliss inlet valves and Bury patented cushion poppet discharge valves, and new improved patent applied for combined proportional intake unloader and vacuum breaker. Altogether it is an ideal equipment of highest economy and for heaviest continuous service to meet most exacting conditions and noiseless in operation. Catalogues illustrating features of this equipment, as well as all other sizes and type of compressors, are available to those interested, upon request.

LOUIS BENDIT has been appointed as manager of the western office of the Hope Engineering & Supply Co., Pittsburg, and will have his office in the New York Life Building, Kansas City, Mo. He will have charge of the sales for that region of the Miller gas and oil engines, 25 to 400-hp., C. & G. Cooper Co., gas engines, 300 to 2,000 hp., Hammon gas pipe couplers and Sprague gas meters.



Power Apparatus

In Shop and Market

New Ideas in Making, Buying and Selling

JEFFREY SINGLE ROLL CRUSHER

CHAIN stokers have created a demand for fine coal in power plant use. The knowledge of the higher efficiency obtained by using coal only in a finely divided state has led to a demand for as small sizes as may be consistent with practical firing. The 2 or 3-in. lump coal, formerly considered satisfactory, has been reduced to one inch and smaller, depending upon the type of stoker. The demand for screenings has grown to such an extent that, in many sections it is already greater than the output of the mine screens. To meet this demand and to dispose of the surplus lump, many of the coal operators are finding it necessary, and highly profitable, to install crushers for reducing the lump coal to smaller sizes.

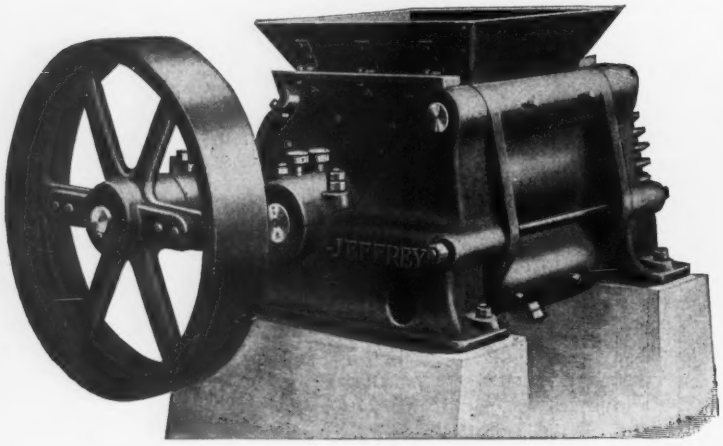


FIG. 1. JEFFFREY SINGLE ROLL CRUSHER

The Jeffrey Single Roll crusher, as shown in the accompanying illustrations, has only recently been placed on the market. This crusher is built for use either at the tipple, or may be mounted on wheels to operate on a track-way over the storage bunkers. The design of this crusher is extremely simple, consisting of a heavy cast-iron plate frame, in which are mounted a crushing roll and a breaker plate. The breaker plate is hinged at its upper edge and held in position by a pair of adjusting rods, enabling the roll to be varied to give any product required.

Toothed segments are bolted to the convex surface of the drum so as completely to cover it. The frame and hopper are so arranged that by removing the light steel guard plates access may be had to the bolts and the segments removed and replaced by new ones without disturbing either the roll or the hopper. This will be found convenient when the crusher is installed in connection with a large hopper or complicated chute. The long hooked teeth not only act as feeders but they positively grip the large pieces and break them up to a size to enter readily the maw of the machine.

Narrow gaps in the shoe of the breaker plate enable the long teeth to pass without dragging oversize pieces with them. This arrangement makes it possible to handle large pieces and reduce them to the requisite fineness.

By making the smaller teeth on the segments of the peculiar shape shown, the proper reduction is made with a minimum amount of slack. The toothed segments are usually made of a very hard iron, each segment being in a single piece. This forms a durable and satisfactory roll surface. For exceptionally severe work, the long teeth are made of cast steel and inserted into the body of the segment.

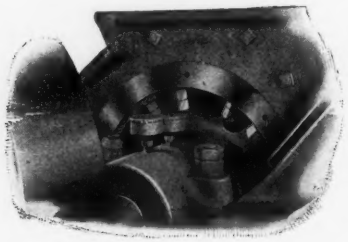


FIG. 3. LOCATION OF SEGMENT BOLTS

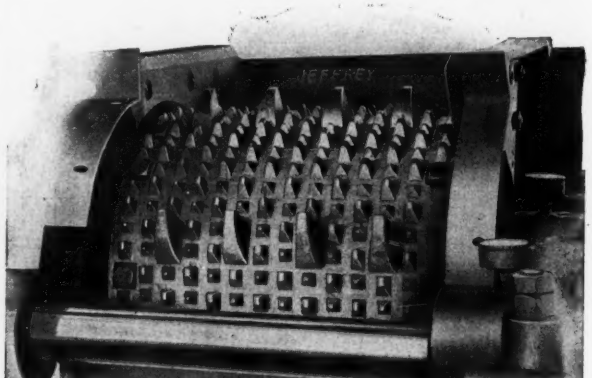


FIG. 2. CRUSHER ROLL SHOWING ARRANGEMENT OF TEETH

The coal is received in any volume without a mechanical device for regulating the feed. By making all

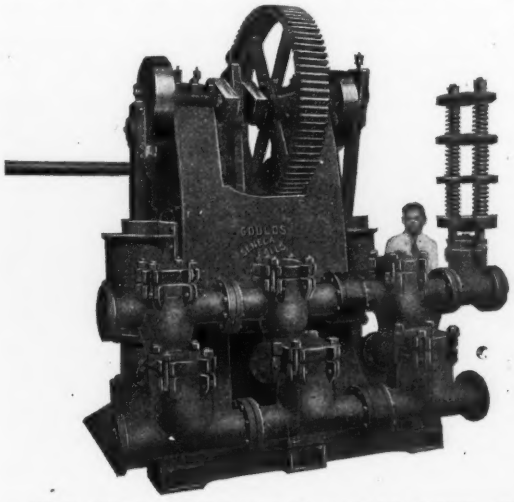
reduction simultaneously, it accomplishes in a single operation the results which usually require 2 operations in 2 separate machines.

The Jeffrey Single Roll crusher is especially adapted for electric motor drive. A belt from the motor pulley to the band wheel on the crusher being all that is usually required. When space is very limited the pulleys and belt are replaced by a pair of gears, having the same safety device.

NEW GOULDS TRIPLEX PUMP

FOR HIGH PRESSURES, 215 TO 1500 POUNDS

A NEW high pressure, single-acting triplex power pump has just been placed on the market by the Goulds Manufacturing Co., Seneca Falls, N. Y. This pump, known as Fig. 1585, is similar to the Fig. 1283 type, which is in general use in mines, waterworks, and with hydraulic elevators, fire protec-



NEW GOULDS SINGLE-ACTING TRIPLEX POWER PUMP

tion systems, hydraulic presses, oil pipe lines, etc. The chief difference is in the gearing. As shown by the illustration, the new pump has only one gear and pinion, which are located between the standards. Figure 1283 had 2 sets, one on either side of the standards.

Placing the gearing between the standards necessarily lengthened one side of the pump somewhat, and increased the distance between the 2 valve boxes on that side. Instead of lengthening the pipe connection between the valve boxes on one set and making each set of different shape, a distance piece is put in as shown. In this way the 3 sets of valve boxes are kept identical in form and interchangeable.

This duplication of parts is a feature of Goulds pumps, which is greatly appreciated by the operator, and one that saves valuable time when repairs are needed.

A HIGH PRICED ARTICLE

WAY back in the dark ages methods of buying and selling were very much like our present day auction sales. Everybody bought just as cheaply as he could, and the selling price of an article was governed by the money-appearance of the customer. The retailer or manufacturer would sell one customer at a high price, only to let the next fellow have the same article at a much lower figure. And in buying, the purchasing agent kept in mind price only; and it was the initial price, for he did not give much thought as to whether or not an article costing more might last three times as long.

But as this good world becomes older, the people in it are in turn becoming wiser. They are tired of bartering for this, that, and the other thing. A buyer now-a-days has to look further than the initial price of an article. He must keep his mind on daily economy in the opreation of his plant. And to do this he is willing and glad to pay more for an article that lasts a long time, rather than get something cheaper.

But, this Mr. Purchaser, is a very inquisitive person. He says: "You show me where your product, costing half as much again as the product I am now buying, will last twice as long, and I'll buy your stuff." He wants more than the price. It is all very nice to have a good catalog full of prices for this and that, but he wants to know why. He is governed by the in-quality of the ingredients and make up of an article, and by the out-quality, the results produced.

In the belt dressing manufactured by the Stephenson Mfg. Co., of Albany, N. Y., which has made it since 1888, is found a dressing of the highest quality which is sold at an adequate price. The thought of the company has been quality dressing for quality folks and the making of a dressing which will last and give satisfaction.

BIG VENTILATING FANS

COOLING RAILROAD TUNNELS FOR THE COMFORT OF PASSENGERS

IN one of the tunnels under the City of Baltimore, the Pennsylvania Railway Co. is installing a large ventilating plant. This tunnel has a length of 4963 ft. with a cross sectional area of 432 sq. ft., the crown of the tunnel being 19 ft. above the rails at the portals.

Above one of the portals is located a fan room measuring about 30 ft. by 36 ft. by 16½ ft. in height, the

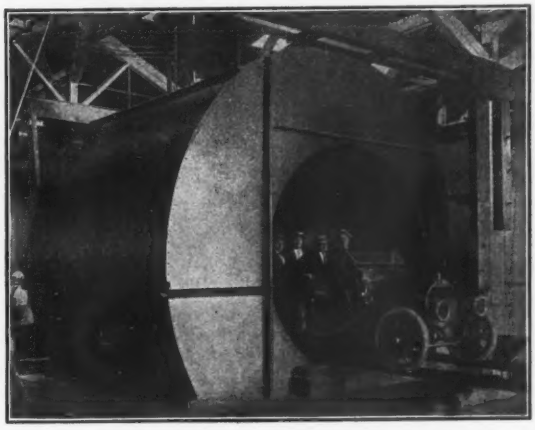


FIG. I. THE BIG FAN CASING IN THE SHOP

floor of which is about 28 ft. above the tracks, and in this fan room are 2 enormous Sirocco fans each measuring 15½ ft. high above the floor, 18 ft. in length and 14 ft. in width, together with electric motors and driving mechanism for transmitting the power from the motors to the fans. Some idea of the huge size of these fans can be gained from the photograph taken in the shops while the fans were under construction, showing an automobile in one of the inlets, which is 11½ ft. in diameter. On the other side of this fan is another inlet of the same size.

Both of these fans have outlets 8½ by 14 ft., which discharge downward through the floor into a chamber surrounding the upper part of the tunnel, the air being discharged from the chamber through a long tapering nozzle carried around the entire perimeter of the tunnel above the tracks in such a way as to direct the flow of air forward much the same as it would from an injector.

The fan wheel or impeller is 12½ ft. diameter and breadth with a plate, dividing the breadth into halves, air entering from both sides. The relative proportions of this fan wheel are more readily apparent in the photograph where it is shown near the end of a box car. It will be noticed that it is about as high as the car, is 50 per cent wider and of almost half the length of it.

Only one of these fans is intended to be run at a time, the other being held in reserve for use in case of accident. It was determined that this tunnel would require 450,000 cu. ft. of air per minute, giving a

FIG. 2. THE FAN WHEEL READY FOR LOADING

velocity through the tunnel of 1040 ft. a minute or at about the rate of 12 miles per hour, and will give an air change in 4¾ min.

When a train is going through the tunnel in the same direction as the air current, the available area for the passage of air being so greatly reduced causes the air to travel much faster than the train; hence, any smoke from the locomotive is pushed before the train so fast as to give the engineer a clear view of the tracks, thereby enabling him to stop the train easily in time to avoid accident. The movement of air is so rapid as to make it perfectly comfortable for the passengers and train crew at any and all times, even if the train comes to a dead stop for a prolonged period.

Four hundred and fifty thousand cu. ft. of air, as handled every minute by one of these fans, weighs about 33,500 lb. or 16¾ tons. This weight of air is about the same as that of 5000 bricks or 130 barrels of water.

The shaft which supports one of these fan wheels is 13½ in. in diameter where it passes through the hub and tapers down to 10 in. in the bearings. It is about 18 ft. in length and weighs nearly 4 tons. To discharge the volume of air required and overcome the frictional resistance of the tunnel, the fan wheel must revolve at a speed of 104 r.p.m., which gives a speed to the tips of the fan blades of about 46½ miles an hour, and will require about 190 hp. to drive it.

Charles S. Churchill, chief engineer of the Norfolk & Western Railway Co., Roanoke, Va., designed the plant where these fans are to be installed, as he has several others, notably the Galetzin, Big Bend and Elkhorn tunnels for the Pennsylvania Railway and the Norfolk & Western Railway. Previous to the installation of the ventilating plant at the Elkhorn tunnel at Coaldale, W. Va., on the Norfolk & Western Railway, it required from 17 to 55 min. to clear the tunnel of smoke; the temperature inside the tunnel became about 30 deg. higher than the outside temperature after a train had passed through and during the 4 years immediately preceding the installation of the ventilating plant, 26 men were asphyxiated in the tunnel.

After the installation of the ventilating plant, smoke would appear at the portal ahead of an engine 2 min. before the train appeared and in less than a minute after the engine had passed out, even the steam had vanished from the roof where it usually clings so persistently.

East bound trains which have to run up grade now pass through the tunnel in 5½ min., and one train can follow the other as rapidly as it is safe to place them, regardless of the tunnel.

Installation of this ventilating plant made it possible to increase the load of east bound trains about 100 tons, saving 4 east bound trains per day on a run of 11 miles, which represents a net saving over and above the cost of operation of from $17,000 to $20,000 a year.

All this goes to show that the ventilation of a railway tunnel, aside from the comfort afforded the employes and the passengers, as well as the possible saving of lives, is just as much a profitable investment as it is proven to be in every other application, and accounts for the steadily increasing demand for fans and blowers of all sizes and for all classes of work.

The Sirocco fan used in the installations described is made by the American Blower Co. of Detroit, Mich.

CATALOG NOTES

GEO. M. NEWHALL Engineering Co.'s Reference Book for Engineers is proving most popular in plants and deserves to do so. It is full of meat, but not too tough to digest readily and so served as to make you want more.

WILLIAMS STEAM SPECIALTIES is one of a series of circulars and catalogs gotten out by the D. T. Williams Valve Co., of Cincinnati. This particular book, which is condensed Catalog No. 9 for 1911, tells of check valves, gate valves, steam cocks, water gages, gage cocks, glass fittings, lubricators, oil and grease cups and Cookson steam traps and separators. It is an attractive and informing booklet, convenient shape for the pocket for reference. Besides this other circulars recently issued are No. 1, on 1910 Williams Valves, showing the brass and iron strap valves, etc., No. 2 for 1910, describing Williams Oil and Grease Cups, No. 3, a statement of Why You Should Use the New Cookson steam trap, and special circular illustrating and describing the 3 new specialties, the Cino iron body gate valve, the Warrior independent sight feed for engines lubricated from a central tank, and the Daisy pressed glass grease cup with locking device in the cap. Williams Regrinding Valves, otherwise the "first aid to the steam plant," are described in another interesting booklet which forms a part of the set.

CATALOG No. 160 issued by the Bristol Co. of Waterbury, Conn., contains complete descriptions of Bristol recording instruments for pressures, temperatures, electrical values, speed, time, etc., showing the types of instruments, the details and methods of action and the different charts available.

PAMPHLETS RECEIVED from the Westinghouse Electric & Mfg. Co., include recently issued book-

lets describing alternating-current switchboards, the type C watt-hour meter, type O A watt-hour meter for small loads, D. C. switchboard meters, and Westinghouse electric tailor's iron. Circular No. 1028 on Westinghouse rotary converters describes details of these machines, different sizes and their adaptability for various substation work. Circular No. 1190 describes Westinghouse engine-driven alternating current generator type E running in capacities from 50 to 1100 kilovolt amperes at 60 cycles and voltages from 240 to 2400.

THE APPLICATION OF WIRE ROPE to transportation, power transmission, etc., is the name of an interesting book issued by the Trenton Iron Co., of Trenton, N. J., and is the 1911 edition of its blue book. It contains a number of interesting treatises by Wm. Hewitt on Wire Rope and the Elements of Its Uses, Aerial Tramways, Cable Hoist Conveyors, and the Application of Wire Rope to Haulage, Shafts and Inclined Planes. It is full of vital and valuable facts concerning the rope itself, the methods of manufacture and properties, and the applications in the various fields mentioned in the titles of the different sections. The company will be glad to supply copies of this book to those especially interested in the matter of wire rope usage.

THE GENERAL ELECTRIC COMPANY has just issued Bulletins No. 4837 to 4843 inclusive, which form a series illustrating and describing in detail all of the circuit breakers manufactured by that company, giving applications of circuit breakers, and also notes and diagrams descriptive of standard practice in the use of carbon break circuit breakers for various requirements. Specifications suggested for the use of engineers, architects, and others wishing to secure uniformity in quality of apparatus and illustrations of typical installations of circuit breakers on modern switchboards.

Bulletin No. 4872, under the heading Transformer Oil Dryer and Purifyer, describes an outfit manufactured by the General Electric Company for the purification of transformer oil of all kinds, crude petroleum for oil fired furnaces, insulating varnish and japan, benzine used for cleaning purposes, transformer oil used for impregnating insulating press-board and wood, cylinder oil used in certain types of electrical apparatus, and viscous insulating compounds. The apparatus consists of a revised and remodeled design of the best type of filter press available, a pump, and a motor for driving. All are mounted on standard steel I beams which form skids and greatly facilitates handling. The outfit may be mounted on iron wheels if desired.

FROM THE UNITED STATES Graphite Co., of Saginaw, Mich., comes an interesting and attractively printed pamphlet on the management and cleaning of steam boilers. It not only shows how graphite can help in avoiding the formation of hard scale in the boiler, but also gives details, rules, and direction for care and management of boilers, which will give the best results as to steaming as well as keeping them free from scale.

MESTA MACHINE CO., of Pittsburgh, has issued an interesting booklet showing some of the works in progress at the time of the visit of the American Society of Mechanical Engineers to its works, also a group of pictures of the society on the occasion of that inspection trip. This is an attractive pamphlet and one which will be appreciated by all who have had the pleasure of visiting the Mesta Co.'s plant.

TRADE NOTES

THE GANDY BELTING CO., of Baltimore, sole manufacturers of the Gandy Belt in the United States, has adopted a novel as well as an entirely original idea for distinguishing the Gandy Belt from the other stitched cotton duck belts. Commencing Sept. 1, 1911, one edge of the Gandy Belting will be painted green, while the rest of the belt will remain red as before, and it will continue to bear the brand "THE GANDY BELT," and the trade mark, a coil of belt and a bale of cotton laid across it, printed upon the belt at intervals throughout the entire length of the roll, the name as has been the rule heretofore.

The Gandy Belt has always had 2 distinctive marks, first, the words "The Gandy Belt," and second, the trade

mark shown herewith. To make it still easier for buyers to make certain of Gandy belting, the company has added the other distinguishing feature.

The foundation of the Gandy belt is a very heavy cotton duck, woven in the duck mills of the Gandy Co. The sewing machines on which the belts are stitched are built in its own machine shop, and have features possessed by no other sewing machine, in that they stitch with an imbedded stitch, making the surface of the belt smooth and holding the plies solidly together. The belt is then treated by a secret process, to render it water, heat and steam proof, and is thoroughly stretched and seasoned before leaving the factory, so that it is uniform in width, runs straight and true, and will not slip or harden.

THE LIPPINCOTT INDICATOR, reducing wheel and cord take-up device which A. C. Lippincott of Newark, N. J., donated to the educational committee of the N. A. S. E. was awarded to E. J. Rose, No 1, Detroit, Mich., for the best essay on indicator work.

Mr. Lippincott writes us that his indicator recently finished a test for endurance which seems almost beyond belief. He states that this instrument made three million, six hundred and ninety-two thousand five hundred and sixty strokes, and at the end was apparently in perfect condition, the piston, by micrometer test showing exactly the same size as at the start. This test was made by Wm. Barr, engineer of the Richardson Building, Newark, N. J., who certifies to its accuracy.

THE GOLD STOP WATCH, offered by A. W. Chesterton & Co., at the Cincinnati convention, was won by W. H. White of the Rochester Railway and Light Co., Rochester, N. Y.

AT THE RECENT Cincinnati Convention, prizes offered by the Ashcroft Mfg. Co., were drawn for, and the contest resulted as follows: First prize, Tabor Steam and Gas Engine Indicator with Houghtaling reducing motion was won by G. W. Booth, of Ironton, Ohio. The second prize, an Ashcroft averaging planimeter, by J. A. Murray of Denver, Colo., the third, a Coffin averaging planimeter, by C. William, Providence, R. I., and the fourth, an Ashcroft Combination Valve Grinder, by L. A. Henderson, of Clinton, Ia.

PRACTICAL ENGINEER CLASSIFIED ADVERTISEMENTS

Advertisements in this section are inserted under regular headings at the rates of 40 cents per line. About nine words make a line. No display type allowed, but the first three words may be set in capital letters. Minimum space sold, two lines.

Under classification, "Positions Wanted," advertisements not exceeding four lines will be inserted for subscribers once free of charge.

To insure proper classification, copy must reach this office on or before the 20th of month preceding publication.

Positions Wanted

POSITION WANTED—Detroit Agency by steam, electrical engineer. Experienced in selling specialties in above lines. Address C. O. R., 112 24th St., Detroit, Mich.

POSITION WANTED—In power plant as engineer. Eight years practical experience and technical training. Now employed as chief in electric plant. References furnished. Address Box 252, Carrollton, Ill. 10-2

POSITION WANTED—By live, energetic, up-to-date gas engineer and electrician. 14 years experience with several makes of engines. A. and D. Current. Good erector. Neat, reliable, strictly sober and a hustler. Can go anywhere at once. Address Box 189, Practical Engineer, Chicago, Ill. 10-2

POSITION WANTED—By an experienced engineer. Have 10 years practical experience. Have held position of chief operating engineer for railway company for the past five years. Can furnish best of references as to my ability in handling steam and electrical machinery. Technical education. I am up-to-date, can read an indicator card and know how to get the steam out of the coal. Can run a plant so it will earn money for its owner. Address Box 188, Practical Engineer, Chicago, Ill. 10-1

POSITION WANTED—Engineer would like to take charge of small plant or act as assistant in large one. Have had 7 years' experience. Familiar with the operation of both A. C. and D. C. generators. W. Break, 136 Jones St., Detroit, Mich. 8-3

Help Wanted

HELP WANTED—ENGINEER WANTED in every city and town to instruct our customers in indicator practice. If you have a fair working knowledge, we will "do the rest." Good pay to reliable, intelligent men. See our adv. on page 31. Write for particulars. Lippincott Co., Newark, N. J.

AGENTS WANTED—TO SELL LUBRICATING oils, belts, hose, paint, varnish for power machinery, to factories, mills, auto owners, stores, threshers. Exclusive territory to right party. Oil experience unnecessary. Manufacturers Oil and Grease Co., Cleveland, Ohio. 8-tf

ENGINEERS AND MECHANICS—To make big money selling Incomparable "ZIZ" Hand Soap. A 10-cent can will instantly remove more dirt and stains from the hands than four cakes of any soap made, and will not injure the most delicate skin. Small sample free. Byram Mfg. Co., Box 3133, Boston, Mass. 4-tf

AGENTS WANTED TO HANDLE ESTABLISHED steam specialty which is known all over the country. Can be handled with non-conflicting specialties. Will give exclusive agency only for amount of territory actually covered by agent or his salesmen in the following states: Virginia, North Carolina, South Carolina, Oklahoma, Wyoming, Georgia, Arizona, New Mexico, Montana, Idaho, Florida, Arkansas, North Dakota, South Dakota. Address Post Office Box 1754, Pittsburgh, Pa. 9-tf

COMPETENT AND EXPERIENCED stoker erectors at once. State age, experience, reference and salary expected. Give full details. Address Box 168, Practical Engineer, Chicago, Ill. tf

BE AN AGENT FOR Practical Engineer in your city. Pleasant part or whole time work calling on your engineer friends. Liberal cash commission on every subscription taken. Write to Subscription Dept. for information. 7-4

Wanted

IF YOU ARE a night engineer, spend a few hours each day taking subscriptions for Practical Engineer. You will be paid well. Write the Subscription Dept. They will start you in at once. 7-4

WANTED—5,000 STATIONARY ENGINEERS to send us their name and address. A good proposition open to each one. For full particulars, write Henry W. Lord, 7 S. Greene St., Baltimore, Md. tf

For Sale

FOR SALE—1-125 HORSE POWER, 3 cylinder Webber Producer Gas Engine. Good as new. Used but 3 months. Board of Public Works, South Haven, Mich. 10-2

FOR SALE—INDICATOR, REDUCING WHEEL, planmeter best make in fine order. Examination allowed before payment. Price low, in fact a sacrifice. Address Mrs. N. L. Browning, East Orange, N. J.

FOR SALE—One H. S. IDEAL ENGINE, 17x16, 250 Rev. center crank, 2 flywheels 78x20 and 18x14. Endless belt to go with same 68 feet by 18 inches for the sum of $600.00 cash. Address Fred Hohmann, City Clerk, Blue Island, Ill. 7-4

Patents and Patent Attorneys

PATENTABLE IDEAS WANTED—Send for 3 free books. R. B. Owen, 28 Owen Bldg., Washington, D. C 7-tf

PATENTS FOR SALE on three different types of steam traps, including the patterns and drawings for same. Address Box 186, Practical Engineer, Chicago, Ill. 9-tf

PATENTS—H. W. T. Jenner, Patent Attorney and Mechanical Expert, 608 F St., Washington, D. C. Established 1883. I make a free examination and report if a patent can be had and the exact cost. Send for full information. 10-tf

PATENTS—C. L. Parker, late Examiner U. S. Patent Office, Attorney-at-Law and Solicitor of Patents. Patents secured promptly and with special regard to the legal protection of the inventors. Handbook for investors sent upon request. 186 McGill building, Washington, D. C. 4-tf

Miscellaneous

MAKE MONEY on the side. Here's your chance to pick out some money for yourself. Get subscriptions for Practical Engineer. It pays well. Just drop a line to the Subscription Dept. They will tell you how. 7-4

EVERY ENGINEER should be posted regarding the new system of vacuum heating installed without payment of royalty; I have valuable information; write to-day. T. L. Reeder, 1413 W. Jackson Blvd., Chicago, Ill. tf

THE VULCAN SOOT CLEANER offers an exceptional opportunity for power specialty salesmen. The Vulcan Soot Cleaner is adapted to all types of boilers. For particulars address G. L. Simonds & Co., No. 803 Steinway Building, Chicago. 7-6